Vol. XXII. Part 3.

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NATIONAL MUSEUM MELBOURNE

The Journal of the Department of Agriculture of Victoria, Australia.

March, 1924.

PRINCIPAL CONTENTS

Wheat and Its Cultivation

Dookie Crop Competition

Standard Herd Test Quarterly Report

The Value of a Bull

Poultry in the Orchard

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VICTORIA, AUSTRALIA.

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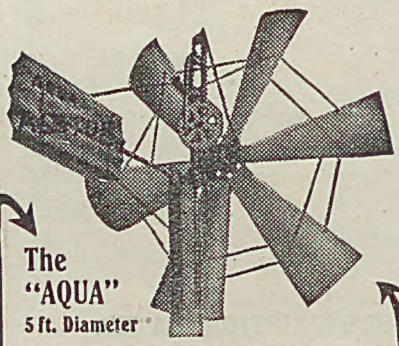

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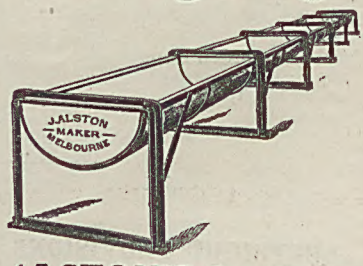

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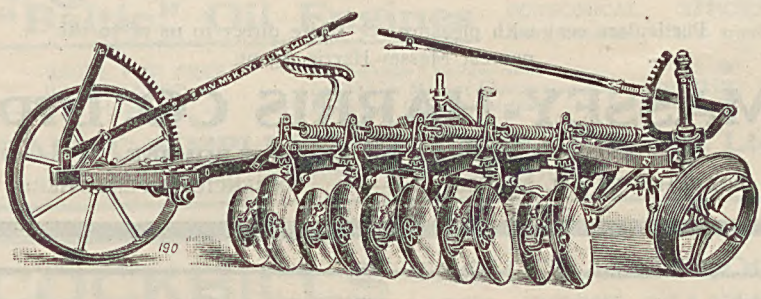

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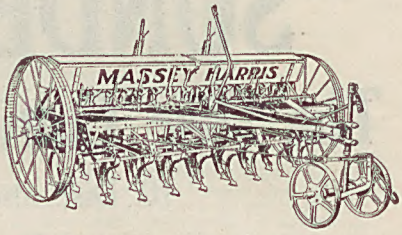

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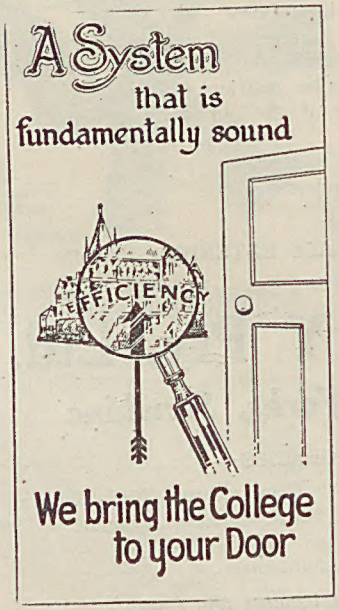

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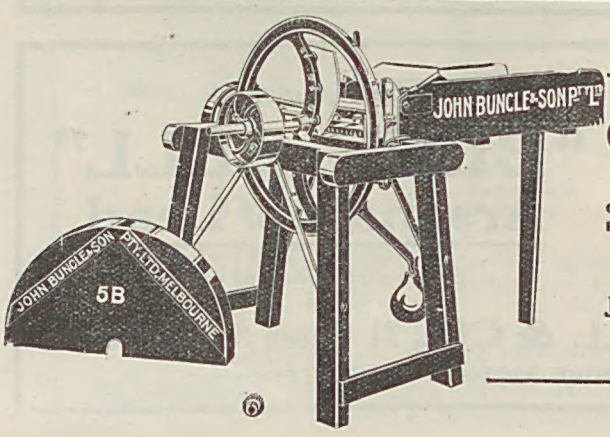

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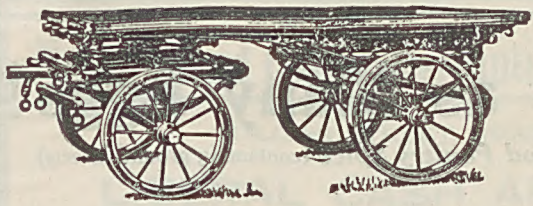

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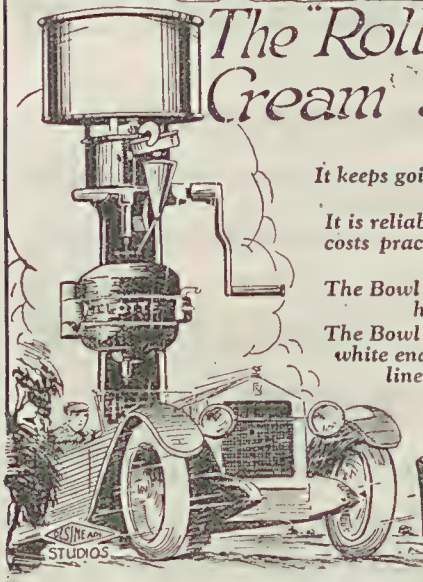

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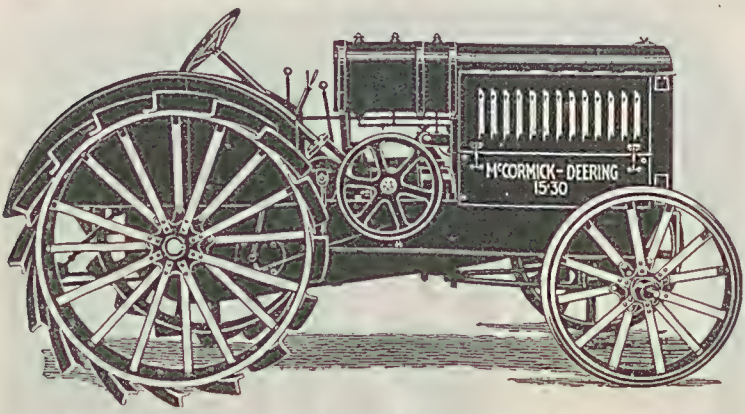

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WHEAT AND ITS CULTIVATION.

(Continued from page 76.)

By A. E. V. Richardson, M.A., B.Sc., Agricultural Superintendent.

II.

SOILS OF THE VICTORIAN WHEAT BELT.

Soil Surveys.

In some countries systematic soil surveys have been conducted to determine the actual location, boundaries, and area of every distinct type of soil in the State. Such a survey may be regarded as a graphic inventory of the soil resources of the country.

A survey of a given area consists of a map, together with a detailed description of the soils and sub-soils of the region, taken to a depth of 3 to 6 feet. The map is compiled in the field by well-trained men, who carefully study the soils, examining the deeper layers by means of borings made with an auger constructed for the purpose. In determining the types, the origin, mode of formation, colour, sub-soil features and physical condition are taken into consideration, and the text or description carries not only a full account of the character of the soil, but, incidentally, of the region studied, its topography, drainage, transportation facilities, crops grown, cultural methods practised, and possible methods of improving the quantity or quality of the product.

A soil survey is a fundamental and vital necessity in the systematic development of a country. If a thorough survey of the soils of a State be made, it is possiblie to apply the results obtained on any given soil type to every other similar type of soil in the State.

It is essential in the newer lands to help to direct the energies of the people to the regions most suitable for crop production, and to prevent the waste of wealth and man power in years of unproductive effort on unsuitable lands. It forms the foundation on which future development may be based.

No such surveys have been attempted in Victoria. Various workers have recorded the mechanical and chemical analyses of certain types of soil, but no attempts have been made to delineate in a systematic manner the location areas and boundaries of these types, and their relationship to the underlying subsoil.

What makes a Soil Fertile?

Soils vary widely in their fertility or productive power. The productive capacity can usually be gauged by the character of the vegetation it supports, and, more particularly, by the grass it naturally carries.

The selling value of farming land usually bears a close relationship to its productive capacity. An improvement in cultural methods, however, may make a great difference in the cropping possibilities, and bring about a material increase in land values.

Twenty years ago the so-called "black land" of the Wimmera sold at £5 per acre. Recently (1923) these lands have been sold at prices ranging from £20 to £25 per acre. The increased price has resulted from the greatly increased crop yields made possible by improved cultural methods.

Soil fertility is a complex of many factors—climatic, chemical, physical, biological. The happy combination of the following conditions results in a fertile soil:—

(1) Favorable climatic conditions.
(2) Richness of soil in available plant food.
(3) Good mechanical condition or texture.
(4) Possession of a bacterial flora of the right type.

The maintenance and improvement of the fertility of the soil is one of the most important problems confronting the agriculturist. It is the beginning and end of good farming.

Man has little or no control over the climatic factors. He may supplement the rainfall by irrigation, or conserve moisture in the soil by bare fallowing, or breed drought-resistant plants, and thus greatly increase production. He can remove excessive rain water by drainage; but beyond this he can do little to modify the effects of climate.

The chemical nature of the soil is determined by its origin, mode of formation, and the amount of leaching to which it has been subjected.

Fertile soils contain an abundance of the mineral nutrients necessary for crop production in an available form. If soils are deficient in these necessary mineral nutrients, the lack may be remedied by intelligent manuring.

Even in this case a chemical analysis of the soil may be misleading. The best method of determining actual deficiencies is to conduct field tests in which various manurial combinations are used.

The mechanical condition or texture of a soil has an important influence on its fertility. The texture is determined by the size of its particles and the amount and nature of its binding materials. The

particles are classified according to size into gravel, coarse sand, medium sand, fine sand, very fine sand, silt, and clay. Neither coarse sandy soils nor heavy clays are naturally fertile, the former because the particles are too large, their capacity for holding moisture and plant food limited, and their capillary power low; the latter because the particles are so fine that percolation and capillary action are extremely slow, and it is difficult to maintain a proper balance of moisture and air in the soil.

The most fertile soils are the loams standing midway between the open porous structure of the sand and the coherent impervious character of the clay. The texture may, to some extent, be modified by draining and the use of soil amendments such as lime, gypsum, stable manure, and green manure.

By the biological condition of the soil we mean the character of the microscopic life it supports. The soil is teeming with microscopic organisms, many of which, particularly the nitrogen-gathering and nitrogen-fixing bacteria, are of the utmost value to the farmer.

Broadly speaking, there are useful and harmful organisms in the soils, and the activity of the former is promoted by the same sort of conditions as are necessary for the proper growth of plants, *i.e.*, air, moisture, warmth, and a sufficiency of organic matter and lime. Hence if a soil is in good tilth, and thus in a condition favorable for crop production, it is also in a fit condition to promote the activity of the useful soil organisms.

Summing up, we may thus say that to be fertile a soil must be satisfactory from three points of view:—

(1) It must contain sufficient plant food in an available form.
(2) It must have a satisfactory texture or soil structure.
(3) It must support a vigorous soil flora of the right type.

The chemical analysis serves to throw light on the nature and condition of the plant food present in the soil.

The mechanical analysis informs us as to the constitution or physical make-up, and its probable tillable qualities.

If these analyses are read in conjunction with the results of actual field tests, they will be most informative in deciding what cultural and tillage methods should be applied to the soil.

Victorian Wheat Soils.

The soils of the Mallee, Wimmera, Northern and Western plains vary considerably in texture and chemical composition. These differences have been well brought out by Howell* in a comprehensive study of the chemical and mechanical analyses of Victorian wheat soils.

As we have already seen, the texture of a soil is largely determined by the relative proportions of coarse and fine grained materials present. If the (*a*) gravel, coarse, medium, and fine sand are considered as *coarse*-grained material, and the (*b*) very fine sand, silt, and clay as *fine*-grained material, we have a basis for comparing and contrasting the soils of the various districts. The following table, taken from Howell's work, indicates in a striking manner the relative proportions

* Howell, F. J. (1911), *Soil Problems in Wheat Growing*, Robertson, Melbourne.

of coarse and fine grained material in representative soils of the four districts:—

Table showing Relative Proportions of Coarse and Fine Grained Material in Representative Victorian Wheat Soils.

	Mallee.	Wimmera.		Northern Plains.	Western Plains.
		Red.	Grey.		
Soil—					
Course-grained material	48·8	44·4	22·03	14·67	5·27
Fine-grained material ..	41·3	46·09	62·87	78·34	86·02
Lime	3·5	·272	2·86	·30	·18
Subsoil—					
Course-grained material	40·4	20·25	11·57	6·05	3·54
Fine-grained material ..	46·60	64·86	68·73	83·57	79·88
Lime	5·0	·76	7·0	·45	·21

This table shows the relative proportions of coarse and fine grained material in representative soils of these wheat districts.

The finest grained soils, and those most difficult to work, are the soils of the Western Plains and the Northern Plains. The soils of the Mallee, on the other hand, contain more coarse material than fine. They are, therefore, easily worked, and very friable. The Wimmera soils occupy a position intermediate between the Mallee soils on the one hand and those of the Western and Northern Plains on the other.

These variations in the proportion of coarse-grained material bear an important relationship to the ease of cultivation of the soil, permeability of the soil to water, and resistance to root penetration. The soils of the Northern and Western Plains have a very high proportion of fine-grained particles, and are, therefore, difficult to cultivate and bring to a satisfactory tilth. They are of great retentivity, and not readily permeable to water, and offer much resistance to root development. Crops, therefore, suffer badly in very wet seasons. The Mallee soils, on the other hand, are very friable and permeable, may be worked with a minimum of team strength, and are easily brought to a good tilth. The Wimmera soils are intermediate in these qualities between the stiff tenacious soils of the Western Plains and the friable qualities of the Mallee soils. The grey-black soils of the Wimmera are of especial interest. They contain a high proportion of fine-grained material—much higher than the red soils of the same district. Notwithstanding this, they are more easily cultivated than the red soils, and may be regarded as our most productive wheat soils. The reason for the friability of these grey-black clay loams lies in the fact that they contain a high percentage of carbonate of lime and organic matter. The presence of these constituents exerts a very powerful modifying influence on the texture. The grey Wimmera soils contain ten times the lime content of the red soils, and the presence of this lime, together with the greater organic content of the soil, profoundly modifies the physical properties of the grey soils. We will now consider these soils in more detail.

Mallee.

The "Mallee" comprises approximately 11,000,000 acres in the north-western portion of Victoria. Originally it was covered with a dense scrub of more or less dwarf Eucalyptus, the character of which has already been described. The soils range from almost pure white sand in the so-called "Little Desert area" north of Nhill, and rich red sandy loams, *e.g.*, those of Walpeup, Red Cliffs, and the newer Mallee, to grey calcareous soils and stiff red clay soils, such as are met with in the older settled Mallee areas. Then, again, we find transition areas containing admixtures of red and white, white and grey, grey and red types.

In the extreme north-west, the country is gently undulating, and is traversed by low more or less parallel ridges or dunes, running east and west. The soil on the ridges is of a light sandy character, which drifts readily, whilst on the intervening flat country it varies from sandy loam to clay loam. There are stretches, too, of saltbush country, generally associated with high saline content of the soil, and occasionally with kopi (gypsum), *e.g.*, at Cowangie.

Leaving out the white sandy country, which may be regarded as of little value for cultivation, we may say that the soils may be grouped broadly into two classes—red and grey. The colour of the soil is associated with variations in the chemical and physical character of the soil.

The main difference between these two classes lies in the lime content. The grey soils contain a high lime content, ranging from 6 to 10 per cent., whilst the red rarely contain as much as one-half per cent. Occasionally the percentage of lime in the grey soils exceeds 20 per cent. This quantity would be distinctly detrimental for crops raised under dry-farming conditions, though under irrigation such soils may prove very productive.

The red soils vary in texture from sands to clay loams. The predominant type of soil is the red sandy loam, with a sub-soil resembling the surface soil, but containing a greater proportion of clay.

The grey are invariably richer in mineral nutrients, and contain a higher proportion of lime and organic matter than the red.

The main differences between the red and the great Mallee soils are summarized in the following table:—

Table showing Percentage of Nutrients and Proportion of Coarse and Fine Particles in Red and Grey Mallee Soils.

	Mallee Red.	Mallee Grey.
1. *Percentage of Nutrients Present.*		
Nitrogen	·055	·121
Phosphoric Acid	·040	·060
Potash	·207	·681
Lime	·355	6·725
Organic Matter	3·23	5·70
2. *Proportion of Coarse and Fine-grained Material.*		
Coarse particles	59·5%	38·2%
Fine particles	35·5%	47·2%
Loss on ignition	4·4%	10·3%

The grey soils contain more lime, potash, and organic matter than the red. They also have a much higher proportion of clay and fine-grained particles than the red, which contain nearly 60 per cent. of sand.

Notwithstanding the comparatively fine texture of the grey soils, they are friable and permeable, owing mainly to the ameliorating influence of the large quantities of carbonate of lime present. Both types contain relatively small quantities of organic matter, and this is a course of weakness from the point of view of maintaining fertility.

They are also uniformly low in phosphoric acid and everywhere the response to soluble phosphates is very marked.

The result of departmental experiment plots for the past five years at Cowangie and Carwarp is shown in the following table:—

Table showing Effect of Superphosphate on Wheat Yields in Mallee Soils.

Fertilizer.	Cowangie.	Carwarp.	Average of two centres.
Nil	15 bush. 32 lbs.	9 bush. 48 lbs.	12 bush. 40 lbs.
30 lbs.	18 bush. 32 lbs.	13 bush. 14 lbs.	15 bush. 53 lbs.
60 lbs.	20 bush. 41 lbs.	14 bush. 39 lbs.	17 bush. 40 lbs.
90 lbs.	21 bush. 16 lbs.	15 bush. 29 lbs.	18 bush. 22 lbs.

Wimmera Soils.

There are two distinct soil types in the Wimmera—the red and the grey clay loam. These differ widely in physical and chemical characteristics. The grey soils are much finer in texture, and contain from 35 to 45 per cent. of clay, as compared with from 15 to 30 per cent. of clay in the red.

The grey soils contain nearly three times as much fine-grained material as coarse, while the red contain approximately equal proportions of fine and coarse grained material.

Notwithstanding the much higher proportions of fine-grained material in the grey soils, they are, on the whole, more easily cultivated than the red. The former are sticky and difficult to work when wet, but they break down easily into a powdery tilth when dry. The grey soils are well suited to summer fallowing, as they may be ploughed or disced at any time during the summer months; a highly efficient mulch may easily be maintained on these.

The surface of the land on which the grey soils are found was formerly of a crab-holey nature, but after some years of cultivation it has become more or less level in character. The soil is deep, resting on subsoils of great uniformity, and gradually shades off into a greyish-white sub-soil, which is sometimes from 5 to 10 feet deep.

The colour of the grey soils is due to organic matter and to their high lime content. The grey contains ten times more lime than the red, and more organic matter. Notwithstanding the fine-grained character of the grey soils, the high percentage of lime makes them more friable than the red.

The grey soils are now regarded as the most productive wheat soils of Victoria, and an average of nearly 50 bushels per acre was obtained on them at Longerenong College in 1923. They respond well to intensive working and summer-fallowing, and give remarkably high yields in a wet season. Their great depth and the high lime content of the sub-soil facilitate drainage, and enable surplus water to be stored in the sub-soil, whilst the self-mulching character of the soil when dry retards evaporation of moisture. Such country shows up to advantage in wet seasons. On the other hand, the soils contract when dry, and form large cracks extending for many feet into the sub-soil, and in dry seasons injury to the root system of the wheat plant may result. The red soils are coarser in structure than the grey, and when moist appear to have a good texture. Notwithstanding their coarser texture, they set very hard when dry, and require much working to bring them to a good condition of tilth. To work them to advantage they must be cultivated in a moist condition. For the best results they must be ploughed when they contain just sufficient moisture to enable the harrows to crumble the newly-turned furrow. This is not always possible where large areas of land have to be worked, as these soils dry out rapidly, and set hard. Hence they are usually ploughed on the wet side, so that larger areas may be dealt with, though much cultivation is necessary to bring the whole area to a satisfactory condition of tilth.

The red soils are not of great depth, and they usually overlie a tenacious clay sub-soil. This sub-soil offers great resistance to movement of water and roots, so that in very wet years yields may be materially reduced. The red soils and subsoils contain less organic matter and far less lime than the black. It is mainly owing to the great difference in the lime content of the two classes that the difference in the tillable qualities is so marked. The effect of the high lime content of the grey soil is to bring about a flocculation of the very finest clay particles, and thus impart to soil and sub-soil an openness and mellowness of texture which is so marked a feature of the grey soils. The main differences between the two types of the Wimmera are summarized in the following table:—

Table showing Percentage of Nutrients and Proportion of Coarse and Fine Grained Material in Red and Grey Wimmera Soils.

	Wimmera Red.	Wimmera Grey.
1. *Percentage of Nutrients Present.*		
Nitrogen	·106	·130
Phosphoric acid	·047	·058
Potash	·415	·973
Lime	·272	2·861
Organic matter	5·171	7·474
2. *Proportion of Coarse and Fine-grained Material.*		
Coarse particles	44·41	22·03
Fine particles	46·09	62·87
Loss on ignition	5·19	8·426

The grey soils are richer in nitrogen, potash, and phosphoric acid than the red, and contain much more carbonate of lime. Being of much finer texture, they possess great water-holding capacity and good capillary power.

The presence of such large quantities of lime not only insures a good chemical condition, but assists in promoting the activity of the nitrifying organisms when such soils are subjected to bare fallowing.

An analysis of the first 4 feet of grey soil at Longerenong on 1st March showed the following amounts of nitrate nitrogen per acre.

Table showing Amounts of Nitrogen Present as Nitrate in Wimmera Grey Soils to a depth of 4 feet.

Depth.	Parts per million.	Pounds per acre.
0 inches–12 inches ..	24·07	84·2
12 inches–24 inches ..	8·66	30·3
24 inches–36 inches ..	4·40	15·4
36 inches–48 inches ..	3·40	12·0
		141·9

It is thus shown that the soil in a depth of 4 feet contained 141.9 lbs. of nitrate nitrogen per acre, equal to 946 lbs. of nitrate of soda per acre.

These soils respond to liberal manuring with phosphates, especially where the working has been thoroughly done.

The results of the manurial tests over a period of ten years at Longerenong are summarized in the following table:—

Table showing Effect of Light and Heavy Dressings of Soluble Phosphate at Longerenong College for Period of Ten Years.

Fertilizer.	Yield per acre.	Increase over unmanured plot.
No Manure ..	29·7	..
½ cwt. Super. ..	33·9	4·2
1 cwt. Super. ..	35·1	5·4
2 cwt. Super. ..	37·2	7·5

Superphosphate gave better results than other phosphatic manures. The heaviest dressing (2 cwt. per acre) gave the best and most profitable increase in yield. The average yield per acre from the 2 cwt. dressing was 3.3 bushels greater than the light dressing (56 lbs.), which was the average quantity of fertilizer used in the Wimmera District when the experiments were commenced. Nitrate of soda applied with the seed gave no increase in yields.

Northern Plain.

The soils of the Northern Plain are fairly uniform in colour and in chemical composition. They differ considerably in texture. There

are limited areas of country, *e.g.*, Bamawm, where the soils approximate in texture the red sandy loams of the Mallee. These are highly valued for irrigation, especially for the cultivation of fruit and lucerne. The native vegetation of such districts was invariably pine and box country. There are areas of "plain" country where no native timber formerly existed; the soils on these are usually shallow clay loams resting on stiff clay sub-soil.

The greater portion of the Northern Plain consists of brownish-red silt loams overlying a heavy red clay sub-soil. Towards the foothills of the Divide the soils are grey silt loams resting on a reddish-grey silty subsoil. These soils were more or less heavily timbered with various species of box. Compared with the soils of the Mallee and the Wimmera the soils of the Northern Plain are much finer in texture, containing a higher proportion of silt and clay. Unlike the fine-grained Wimmera grey soil, these Northern soils are very deficient in lime, and the organic content of the soil is not high. The sub-soils are usually stiff and tenacious, containing a much higher proportion of clay than the surface soils.

The high percentages of fine-grained particles present in these Northern soils, in the absence of adequate amounts of carbonate of lime, imply that they are close in texture, tenacious, tend to set hard, and are difficult to bring to a satisfactory tilth. They are very retentive of moisture, but are of low capillary power. As the underlying subsoil is stiff clay, water penetrates with great difficulty. The addition of organic matter, and especially of lime or gypsum, would materially improve the texture of these fine-grained soils and sub-soils.

The important practical point to consider is whether the cost of such soil improvement would be covered by the probable increase in crop returns. Experiments are in progress to test this matter.

The following table summarizes the nutrients and proportions of coarse and fine grained material in typical soils of the Northern and Western Plains:—

Table showing Percentage of Nutrients and Proportion of Coarse and Fine Grained Material in Typical Soils of the Northern and Western Plains.

	Northern Plain.		Western Plain.	
	Soil.	Subsoil.	Soil.	Subsoil.
1. *Percentage of Nutrients.*	%	%	%	%
Nitrogen	·108	·045	·167	·107
Phosphoric acid	·068	·054	·064	·061
Potash	·442	·775	2·54	·673
Lime	·305	·456	·182	·219
Organic Matter	4·97	*	6·21	*
2. *Proportion of Coarse and Fine-grained Material.*				
Coarse particles	14·67	6·05	5·27	3·54
Fine particles	78·34	83·57	86·02	79·9
Loss on ignition	4·97	5·93	6·5	9·2

* Not determined.

Western Plains.

The soils of the Western Plain differ from those of the remainder of the Wheat Belt in origin. The wheat area is practically all of volcanic origin, of very fine texture, usually containing an admixture of small, rounded ironstone pebbles called buckshot. These pebbles improve the physical condition of the soil, which would otherwise be exceedingly difficult to work owing to the high proportion of fine-grained material —clay and silt.

The mechanical analysis of a soil is made on the "fine earth," and does not take into account stones and gravel. The buckshot plains extend from Bannockburn to Dunkeld, a distance of approximately 90 miles. On the eastern side the plains are about 20 miles wide; at the western from 40 to 48 miles.

The soils vary from light chocolate to grey silt loams. They are richer in nitrogen than the remaining wheat areas, and contain moderate amounts of organic matter. They show the same deficiency in phosphates as the other wheat soils, and are markedly deficient in lime, probably owing to continuous leaching, due to the comparatively heavy rainfall. They contain an excessive proportion of fine-grained material, mainly silt, while the sub-soils contain excessive proportion of clay particles. Over 40 per cent. of the surface soil consists of silt, whilst the sub-soils contain nearly 50 per cent. of clay. The high percentage of silt and clay makes these soils very impermeable to water, and in wet seasons wheat crops suffer materially. The Western Plains do best with wheat in seasons with relatively dry winters.

There is every reason to believe that the use of a soil ameliorant, such as lime or gypsum, would materially improve the tillable qualities of these excessively fine-grained soils, and the incorporation of organic matter obtained by the grazing of fodder crops with sheep would also improve their texture considerably.

In common with the soils of the Mallee, Wimmera, and Northern Plains, they respond to application of phosphate, and on account of the liberal rainfall one would expect that heavy dressings of soluble phosphates would result in a material increase in crop yield, and in a marked stimulation of the pasturage following the wheat crop.

On the Western Plains fallowing is not necessary to conserve moisture, but it is desirable, because it makes the land mellow, and keeps it clean, and enables the grower to prepare a good seed bed.

Summary.

The wheat soils of Victoria vary widely in their texture and in the amount of nutrients they contain. The nitrogen content is below that of European standards, yet they do not respond to dressings of nitrates. This is mainly due to the great activity of the nitrifying organisms in well-worked fallows in Victoria. The soils of the Mallee are lowest, those of the Western District highest, in nitrogen.

The phosphoric acid content of the soils is uniformly low, and in all cases Victorian wheat soils respond to dressings of water-soluble phosphates. There is no question as to the advisability of applying phosphates, nor is there any doubt as to the form in which the phosphate

can be best applied. There is abundance of evidence to show that heavier dressings of phosphates than are now customary could be used to advantage, and that the wheat crop and the grazing value of grass, especially on the Western Plains, would be materially improved by such liberal dressings.

Potash is present in ample quantities in our wheat soils for all present and probable future requirements. Lime, however, is deficient, especially on those which would benefit most by its presence, *e.g.*, Western and Northern Plains and red Wimmera soils.

The organic content of the wheat soils is uniformly low, and might be increased with advantage, either from the point of view of the effect of humus on the water-holding capacity of the soil or of its capacity to improve the texture.

Regular systems of crop rotation, such as bare fallow, wheat, grass, or bare fallow, wheat, oats grazed with sheep, are suitable for the northern districts, whilst fodder crops grazed with sheep should be introduced into the rotation systems of the Western District.

The soils most easily tilled are those of the Mallee, whilst the most difficult to bring to a satisfactory tilth are the soils of Western and Northern Plains.

The reason for this is the presence of high percentages of silt in the surface soils and of clay in the sub-soils, together with an insufficiency of that excellent soil ameliorant—carbonate of lime. The shortage of lime is a great source of weakness, and there is every reason to believe that an application of lime or gypsum would materially improve the texture of these excessively fine-grained soils.

STRUCTURE AND DEVELOPMENT OF THE WHEAT PLANT.

One of the most interesting chapters in the history of agricultural science is that relating to the discovery of the food requirements of plants. More than a century of investigational work was necessary to establish the fundamental facts of plant nutrition. It is proposed to supply a simple account of the more important facts of plant nutrition and structure, using the wheat plant as an illustration. We will consider the wheat plant from the germination of the seed to the maturing of the crop.

1. Grain.

Structure of the Grain.

The grain of wheat is a nut-like fruit called by botanists a caryopsis, consisting of a single seed enclosed within a thin shell. The seed is so adherent to the inner wall of the shell that the two cannot be separated easily. If a thin section be taken longitudinally through a wheat grain and examined under a microscope with a lower power objective, three distinct structures will be observed, viz.:—

1. Embryo or germ.
2. Endosperm.
3. Protective coats.

Embryo.—At the end opposite the brush will be found the embryo or germ, from which the future wheat plant develops. Careful examination of the embryo will reveal—

(*a*) The plumule, that portion of the germ which develops into the stem and leaves of the young plant, consisting of minute rudimentary leaves enveloped within the plumule sheath.

(*b*) The radicle or rudimentary root, with its root sheath and root cap.

(*c*) Absorptive epithelium, a series of elongated cells lying between the embryo proper and the endosperm, with their long diameters directed towards the endosperm.

Compared with other portions of the grain, the embryo is rich in protein, fat, and ash constituents, and, though it contains a considerable amount of sugar, it has but little starch. Nearly one-sixth of the embryo consists of fat and oil and about one-third of protein, so that these two constituents make up practically one-half the germ. In the process of milling the embryo is removed from the flour.

Endosperm.—By far the greatest portion of the kernel is made up of the endosperm, which acts as a storehouse of food for the young plant during the time it is seeking to establish itself in the soil. The endosperm occupies about 80 per cent. of the kernel. It is principally composed of starch-cells—large elongated cells with their long diameters arranged radially to the surface of the kernel. These, however, are found, on examination, to consist of an outer covering of cellulose, containing a large number of starch grains. Besides these, the starch cells contain a considerable amount of gluten. Fleurent has shown that the quantity varies with the position of the starch cell in the endosperm, and from a detailed examination of a number of Indian, Russian, and French wheats, he was able to show that it increased from the centre to the periphery. In an Indian variety, the gluten varied from 8 per cent. at the centre to 10¼ per cent. at the peripheral portion of the endosperm—the portion of the grain which forms the flour in the process of milling.

Protective coats.—The starchy endosperm and the embryo are both protected by a firm coat, which, on superficial examination, appears to be homogenous in structure. When examined under a microscope, however, this covering membrane is found to consist of several layers of sharply differentiated cells. These various structures serve as a protection for germ and endosperm, and, in the process of milling, become detached from the remainder of the kernel, and collectively form the bran.

At least five different layers may be distinguished under the microscope, besides several irregular, vaguely defined intermediate layers. Examination of a number of varieties of wheat commonly grown in Victoria reveals wide differences in their microscopic appearance, especially in regard to the structure and characteristics of the layers immediately covering the endosperm, and it may be that these microscopical characters are correlated with important external characteristics of the varieties concerned.

An examination of Fig. 1 will reveal the following structures:—

(*a*) The epidermis, which consists of a layer of longitudinal cells with their long axes in the direction of the length of the kernel.

(*b*) A second layer, the epicarp, very similar to the former in general appearance, resting on an irregular layer apparently devoid of cellular structure.

(*c*) The endocarp, placed at right angles to the cells above described. In cross section the cells of the endocarp appear to be very regular in character, with thick cell walls, which in longitudinal section display minute pits.

(*d*) The testa, consisting in the unripe kernel of two layers of cells closely applied to the aleurone layer. The testa is very tough in character, not readily permeable to water, and homogenous in structure.

(*e*) The aleurone layer, consisting of large more or less rectangular cells, with thick cell walls containing oil and granular nitrogenous matter. It is frequently called the gluten layer, though this is a misnomer, as the gluten found in the flour is derived from the endosperm, and not from the aleurone layer.

What is known as bran consists of the five layers described above.

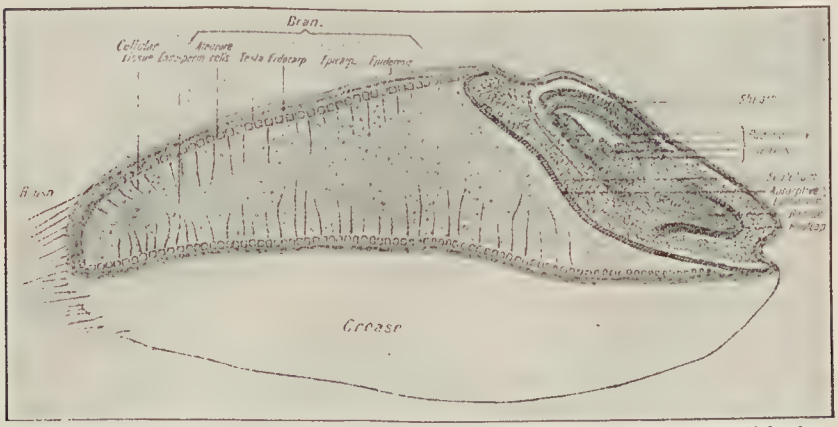

Photo C. C. Brittlebank.

Fig. 1.—Longitudinal Section of a Grain of Wheat, showing the Internal Structure.

Colour and Character of the Grain.

Wheats are usually classified into white or red. The difference is based on the character of the testa. The white wheats possess a colourless testa, whilst in the red an oily colouring material develops in the cell walls during ripening.

The colour is also dependent on the thickness and transparency of the pericarp and the hardness or softness of the endosperm.

The hardness or softness of the endosperm is a characteristic of the variety, but it is also dependent on the climatic conditions during ripening. Durum varieties have a dark glossy or vitreous endosperm. The kernels break with a hard flinty fracture. Most of the common bread wheats have soft opaque mealy endosperm, and break with a floury fracture.

Cool districts with abundant rainfall tend to produce large soft mealy grains, *e.g.*, Tasmania and Western Victoria. On the other hand,

grain produced in dry warm regions is invariably harder than that grown in cool, moist regions. Though flintiness and mealiness of the endosperm is a physical phenomenon, it is correlated with the amount of nitrogen present, the flinty grains being richer in nitrogen than the mealy grains of the same sample. Flintiness can, to some extent, be imparted to a wheat by growing it on a soil rich in nitrogen or by heavily manuring a wheat crop with nitrates.

"Strong" and "Weak" Flour.

Wheats are classed by the miller and baker into strong and weak varieties. Strong wheats yield flour which makes large porous loaves, while weak wheats give a flour which produces smaller but denser loaves. Strong-floured wheats absorb more water to make a dough of a consistency fit for baking than weak-floured wheats. Hence strong-floured or high-strength wheats usually give more loaves of better quality per sack of flour than weak-floured or low-strength wheats. The Australian wheats have the reputation of producing flour of unrivalled colour, and, for this reason, are eagerly purchased on the English wheat market to blend with wheats of other countries. Our wheats, however, are, on the whole, low in gluten content and in strength. It may be that these deficiencies are a characteristic of the climate, and if so we might be inclined to infer that improvement in these respects is improbable. While admitting that the gluten content and strength are in a large measure dependent on the soil and climatic conditions, there is no doubt that these qualities may be greatly improved by crossbreeding. Farrer and Pye have been notably successful in producing such high-strength wheats as Bobs and Minister.

Vitality of Wheat Grains.

Experiments have demonstrated that the germinating power of wheat is usually highest the second year after harvest; after the second year the vitality diminishes rapidly. The length of time wheat grains will retain their capacity to germinate depends mainly on (1) the degree of ripeness and the moisture content of the grain at harvest, (2) the temperature and moisture content of the place of storage. Dry well-ripened grain retains its vitality for many years. On the other hand, grain stored in a humid atmosphere soon loses its germinating power. Percival showed that grains from certain plots at Rothamsted retained their vitality for 25 years, though other samples, harvested in a wet season, failed to germinate after ten years. The reported germination of wheat taken from Egyptian mummies is a myth.

Germination.

The wheat kernel consists of three distinct portions:—(1) Embryo or germ; (2) protective coats; (3) endosperm. The latter contains mainly starch and also proteins, which serve as reserve material for nourishing the young plant.

To bring about germination, three factors are necessary:—(1) Moisture; (2) air; (3) warmth. Under these stimulating agencies, the germ soon enlarges, and the plumule and radicle bursting through the pericarp form respectively the miniature stem and root of the young plant.

Shortly after the primary root appears a pair of lateral roots become visible. These soon attain the same size as the primary root. Within

three or four days two more roots appear, usually immediately above the first pair, and occasionally a sixth rootlet develops at right angles to the rest.

During germination the grain increases in weight and volume owing to the absorption of water. The grain is usually from 33 to 40 per cent. larger when germination takes place.

The optimum temperature for germination is from 68° to 72° F. (20° to 22° C.) and the minimum temperature below which germination is checked is 39° F. (4° C.). There is in germination a loss in dry weight amounting to 1.5 per cent. in 24 hours, 6.7 per cent. in four and a half days, and 12 per cent. in six days. Not only is there a loss in weight, but chemical changes take place which result in a decrease in the value of grain for bread-making.

Important chemical changes take place both in the embryo and in the endosperm during germination. The first supply of food for the young plant is derived from the reserve materials of the endosperm. As these reserves are insoluble in water, they are manifestly incapable of passing out of the cell walls in which they are enclosed.

They must be brought to a condition in which they may diffuse readily from cell to cell. This transformation is effected by the chemical activity of a substance called diastase, which is secreted by the epithelial cells of the scutellum. Diastase belongs to a class of bodies called unorganized ferments or enzymes, and a very small amount of diastase is able to transform practically an unlimited amount of starch into soluble form. It is the diastase which is responsible for the conversion of the starch of the germinating barley into maltose in the manufacture of malt. The diastase transforms the starch into maltose which diffuses from cell to cell until it reaches the growing points of the developing embryo.

Similarly the protein matter of the endosperm, which like starch is insoluble in water, is acted on by a ferment present in the grain, and is broken down into diffusible proteids called peptones. These soluble peptones, as well as other nitrogenous compounds of lesser importance (amides and amino-acids) diffuse from cell to cell and nourish the growing tissues of the embryo. It is not long before the reserves of food in the seed are exhausted, and henceforth the young plant must lead an independent existence.

2. The Root.

The roots of a wheat plant are of two kinds:—

(*a*) Seminal roots, belonging initially to the embryo.
(*b*) Adventitious roots, which spring from the nodes within the soil, or just above it.

The embryo possesses five roots, the primary radicle and two pairs of lateral rootlets. A sixth root may be produced later, and grows out at right angles to the others. The growing point of each root is protected by a root cap, the outer cells of which are continually exfoliated as the tip forces its way through the soil.

At some distance from the root cap the surface of the root is covered with delicate fibrils.

These are the tender root hairs which push their way through the minute interstices between the soil particles and apply themselves closely to the uneven edges of the soil grains. Microscopic examination proves them to be long tubular appendages—mere delicate prolongations of the epidermis. The epidermis forms the external layer of the root, and, as may be seen in Fig. 2, it is composed of cells closely packed together with no interstitial spaces or openings of any kind. In this respect, as will be shown later, it differs from the epidermis of the leaf. From this absence of openings it will be apparent that the plant is quite incapable of assimilating food of a solid character from the soil. Whatever nutrients are obtained from the soil, therefore, must be dissolved in water.

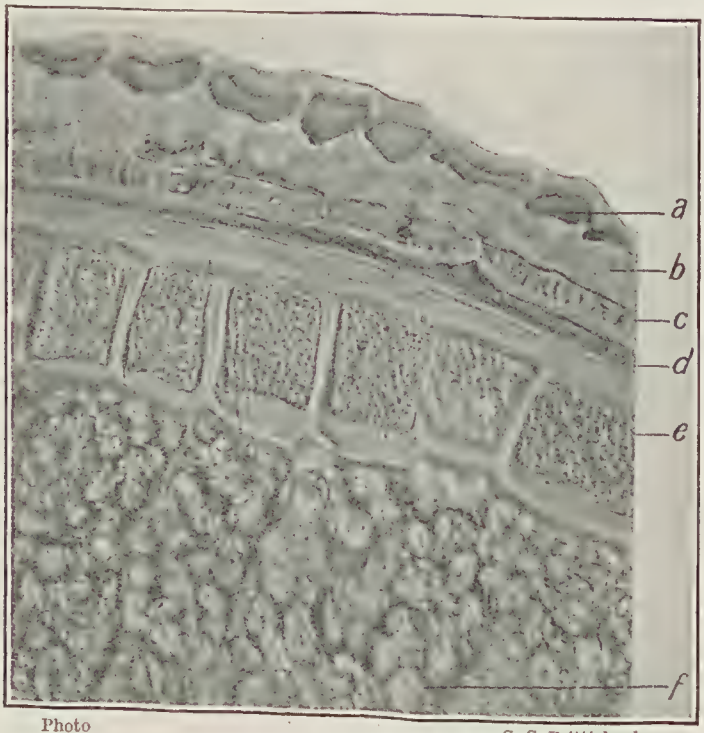

Photo C. C. Brittlebank.

Fig. 2.—Transverse Section of Federation Wheat, x 400, showing Structure of Protective Coats and Endosperm.

The particles that compose a normal soil in good condition are very irregular in shape, and are invested with a film of water. The film surrounding each particle is really a very dilute solution containing various substances dissolved from the mineral constituents of the soil. It is the source of the plant food obtained from the soil. The mode of entry of this dilute solution to the root may be illustrated by a very simple experiment. If a lamp chimney covered over one end with a piece of bladder or of parchment be partially filled with strong brine, and then placed in a vessel of water, the two liquids will be separated merely by the thin membrane. Under these circumstances, each of the liquids will diffuse through the membrane and mix with the liquid on the other side. The attraction for water inwards will be greater

the stronger the brine. The movement will continue until the liquids on both sides of the diaphragm have the same composition. This process is called osmosis, and each cell in the epidermal layer of the root is a

Fig. 3.—Germinating Wheat Grains.

small osmotic apparatus. The cell sap corresponds to the salt solution, the cell wall and protoplasm to the diaphragm or the bladder separating the liquids, and the soil solution on the surface of the soil particles corresponds to water in the vessel.

Fig. 4 — Longitudinal Section through the Root-cap of a Young Wheat Root.

But there is one important difference to be borne in mind. While the protoplasm of the cell readily allows the soil water, bearing in solution plant food, to diffuse inwards and mix with the cell sap, it refuses to allow the bulk of the dissolved substances in the cell sap to diffuse outwards. The osmosis of plant nutrition is, therefore, a controlled osmosis, the control being exercised by the living protoplasm of the cell. The density or concentration of the cell sap must on fertile soil be always greater than that of the dilute solution investing the soil particles, so that the solutions outside may be carried inside the cell and tend to make it tight with water or turgid. The solutions which penetrate the epidermal cells by osmosis, pass from cell to cell in the root tissue by the same process.

In the lower types of plants, such as the algæ, which are composed entirely of simple cellular tissue, the movement of water within the plant may be accounted for by osmosis alone. In the higher plants the transference of water from cell to cell by osmotic agencies alone would be far too slow to keep pace with the water requirements of the leaves.

Specially developed structures are therefore found in these plants, and serve as conducting media whereby the water taken in at the root finds its way rapidly to the leaf.

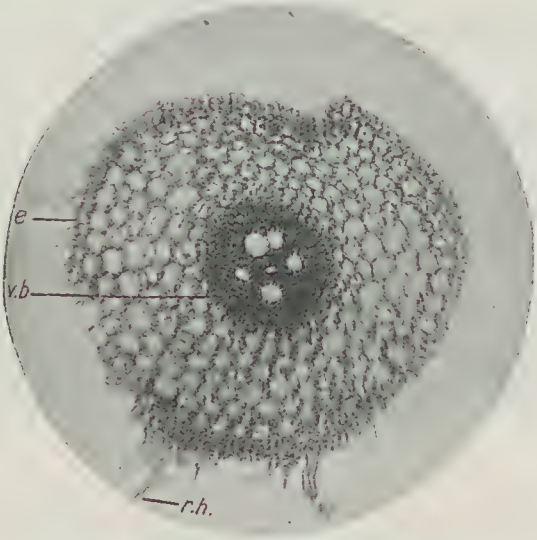

Fig. 5—Transverse Section of a Young Wheat Root showing Root Hairs (*r.h.*), Vascular Bundle (*v.b.*), Epidermis (*e*), and Ground Tissue.

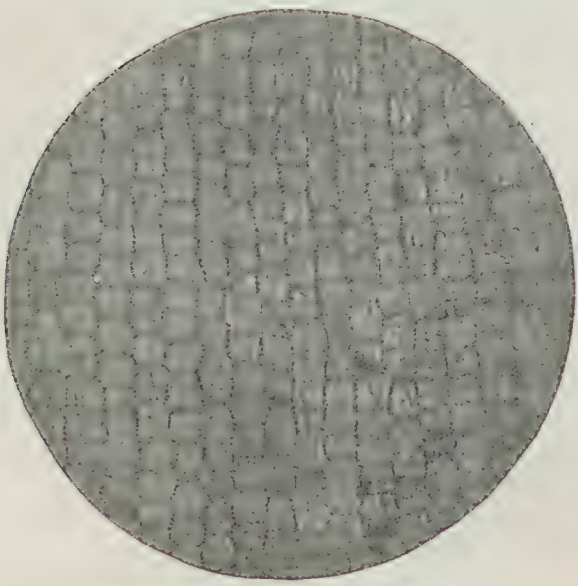

Fig. 6.—Epidermis of Root of Federation Wheat (x 270).

Fig. 5 shows a cross section of a young root of Federation wheat. Several delicate root hairs (r.h.) will be observed, each forming simply an elongated cell of the epidermis. In the centre of the root is the axillary vascular bundle (v.b.), which runs throughout the length of

the root, and ultimately merges into similar structures in the stem. Fig. 9 is a longitudinal section through one of the vascular bundles of the stem. Each bundle consists, mainly, of a series of elongated cells with lignified thickened cell walls, and a variety of long cylindrical vessels forming continuous open tubes, with and without spiral thickenings. These vessels originally contained protoplasm, but during the course of growth the protoplasm was used for thickening the cell walls, and the matured vessels are merely long tubes specially adapted for conducting water. The dilute solution of mineral plant food, which has diffused through the root hair, epidermis, and root tissue, now finds its way to the conducting tissues of the axillary vascular bundle, and is conveyed through similar tissues in the stem to the leaf.

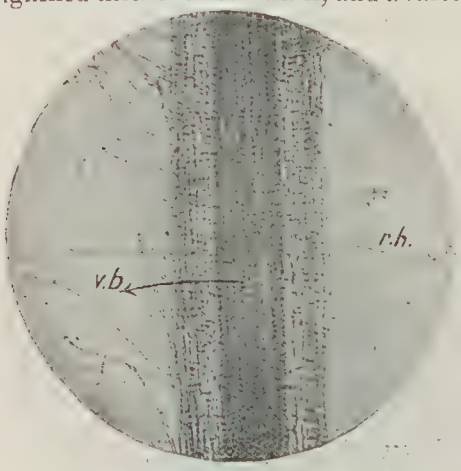

Fig. 7.—Longitudinal Section of Young Wheat Root showing Axillary Vascular Bundle (*v.b.*) for conducting sap, also root hairs (*r.h.*).

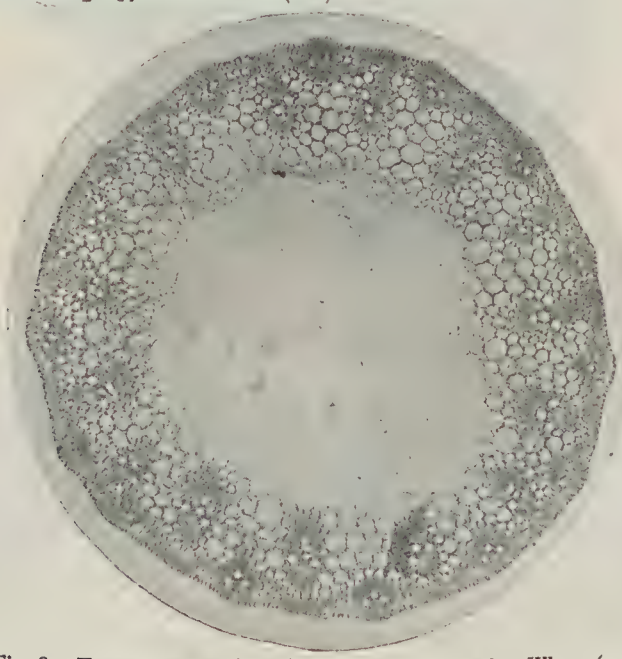

Fig. 8.—Transverse Section of a Stem of Federation Wheat (x 50).

3. The Leaf.

What takes place when the dilute mineral solution reaches the leaf may best be understood by referring to the structure of the wheat blade.

The foliage leaves are arranged alternately in two opposite vertical rows. The leaves are convolute in the bud, the blades being rolled over

from one margin to another. The rolling alternates from leaf to leaf, one in which the right margin is folded over the left being followed by another in which the left margin is folded over the right. The foliage leaves possess a sheath blade, a ligule and a pair of auricles at the base of each blade. The leaf sheath completely envelops the straw, but is split along the upper half. The sheath protects the straw from damage and from insect attacks.

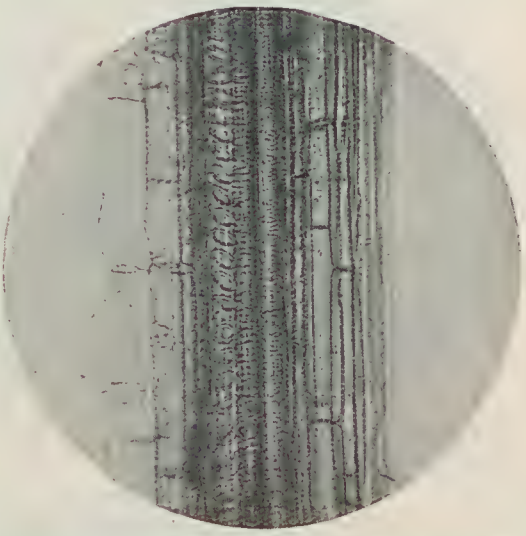

Fig. 9.—Longitudinal Section of a Federation Wheat Stem through the Vascular Bundle showing the Construction of the Conducting Vessels.

The ligule is situated at the base of the upper surface of the leaf blade, and is a thin membranous structure which prevents the entry of insects between the leaf sheath and the stem. It is an almost colourless membrane about 3 to 5 millimetres long.

The auricles are curved appendages, pale green in colour, attached to the base of each blade. The leaf blade is linear and parallel veined, and is twisted in the form of a loose right-handed screw. The width of the blades of the different leaves usually increases as we pass from the lowest to the uppermost leaf. Most varieties have from five to seven leaves, and the fifth leaf is usually the longest.

Fig. 10 is a transverse section of a leaf of Federation wheat. Above and below, the leaf is bounded by a single layer of epidermal cells, and

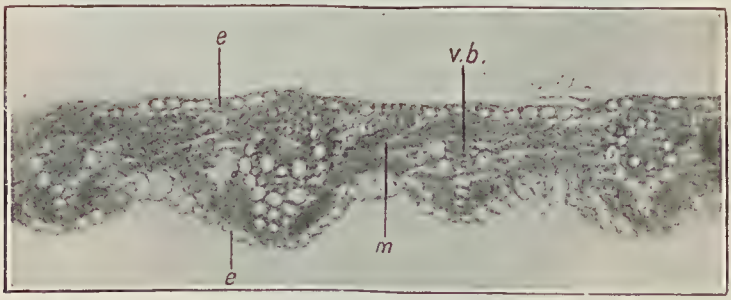

Fig. 10.—Transverse Section of a Wheat Leaf showing Epidermal Cells, Mesophyll, and Vascular Bundles.

lying between is the mesophyll. The upper portion of the mesophyll is typically closer in structure than the lower portion, which is usually spongy in character and contains a large number of intercellular spaces. These intercellular spaces form labyrinthic chambers in which air freely circulates in the interior of the leaf. Scattered through the body

of the mesophyll are the vascular bundles which form in wheat a set of parallel strands serving not only as a skeleton for the support of the remaining leaf tissue, but also as media for the conduction of the sap to every part of the leaf. The cells of the mesophyll contain a large number of green bodies called chloroplasts, or chlorophyll corpuscles, which give the leaf its characteristic green colour.

The epidermis of the leaf, in contrast to that of the root, is studded with microscopic openings called stomata, more or less regularly placed. Each stoma, or pore, consists of two sausage-shaped guard cells joined together at the extremities in such a manner as to leave a very narrow slit-like pore between them. The opening and the closing of these stomata are brought about by changes in the curvature of the guard cells, and this, in its turn, is dependent on the turgidity or water content of the cells. It is interesting to note that in this specimen of wheat the

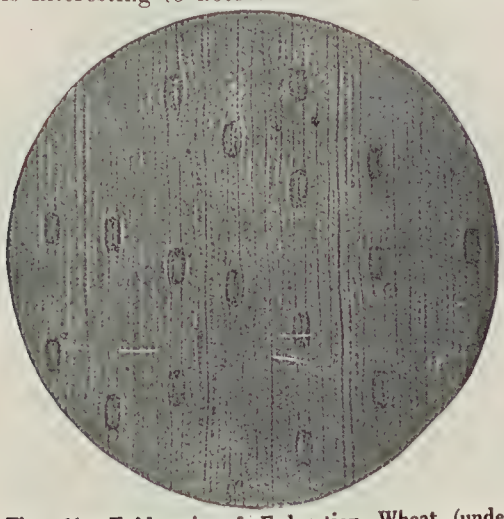

Fig. 11.—Epidermis of Federation Wheat (under surface of leaf) showing Stomata (3,321 per square centimetre).

number of stomata on the upper surface per square centimetre amounted to 3,681, whilst the number on the lower surface was 3,321 per square centimetre.

Functions of the Leaf.

(*a*) *Respiration.*—These stomata are the breathing pores of the plant. Respiration is quite as necessary for the life process of plants as it is for animals, and the process is essentially the same in animals. The stems, roots, and leaves of a plant are constantly in need of oxygen for respiration, and, while under ordinary conditions the aerial portions of a plant can secure a sufficiency of oxygen for their requirements, it not infrequently happens that the roots suffer from lack of proper supplies of air in the soil. This may readily be seen in the unhealthy, sickly yellow appearance of wheat growing in low-lying portions of fields after heavy winter rains, or in badly-drained, water-logged soils. Respiration goes on throughout a plant's existence, and its general effect is to destroy the carbonaceous material of the plant and liberate carbonic acid gas.

(*b*) *Assimilation or Photosynthesis.*—This process of respiration in green plants is, however, overshadowed by the opposite process of assimilation. The leaf is the medium whereby all green plants are enabled to obtain from the air the carbon which forms the greater portion of their bulk. Carbonic acid gas is present in ordinary air to the extent of about four parts in 10,000. Air containing carbonic acid enters the stomata and circulates freely in the intercellular spaces. Under the influence of sunlight, which supplies the necessary energy, and in the presence of the chlorophyll and moisture in the leaf, the carbon of the carbonic acid is fixed by being converted into carbohydrates and oxygen is set free and exhaled by the plant. This process is called "carbon fixation," "assimilation," or, as it is dependent on light, "photosynthesis." The energy necessary to effect these changes is, of course, obtained from the light, and the leaf has transformed the energy of sunlight into potential energy possessed by the newly-formed carbohydrate. Stephenson, for this reason, described coal as "bottled sunlight," because the energy it possessed was derived from the sunlight,

Fig. 12.—Flower of Wheat (magnified).

which, ages ago, assisted to grow the vegetation which we now mine as coal.

This process is of enormous practical importance in the economy of nature. All animals, directly or indirectly, are dependent on the preliminary life of plants to store up food, and green plants have the power of securing the greater portion of the solid matter of which they are composed from the carbonic acid gas of the air. Much discussion has taken place as to exactly what happens in the process of assimilation. In any case, starch may be regarded as the first visible product formed. Starch, however, does not accumulate in the leaf, but is transferred from the leaf to the stem and roots, to be stored till required. The starch is transferred by the agency of an enzyme, diastase, such as is found in the germinating grain. The starch is thus converted to sugar, which, being soluble, may diffuse to such parts as require it. Photosynthesis takes place only in the day-time, whereas respiration is constantly in progress. Respiration, however, is less rapid than the opposite process of assimilation, so that the net result is an increase in dry weight as a result of assimilation.

(*c*) *Transpiration.*—A third function of the leaf is to get rid of the superfluous water taken in by the root-hairs. As the mineral plant food taken in by the root is in the form of a very dilute solution, it follows that a large amount of water must be evaporated in order that the plant may receive sufficient mineral matter to build up its tissues. The superfluous water is vaporized in the intercellular tissues of the mesophyll and passes out through the stomata, whilst the mineral substances remain behind. This important process is called transpiration, and, by its means, the absorption of fresh supplies of mineral food from the soil is rendered possible.

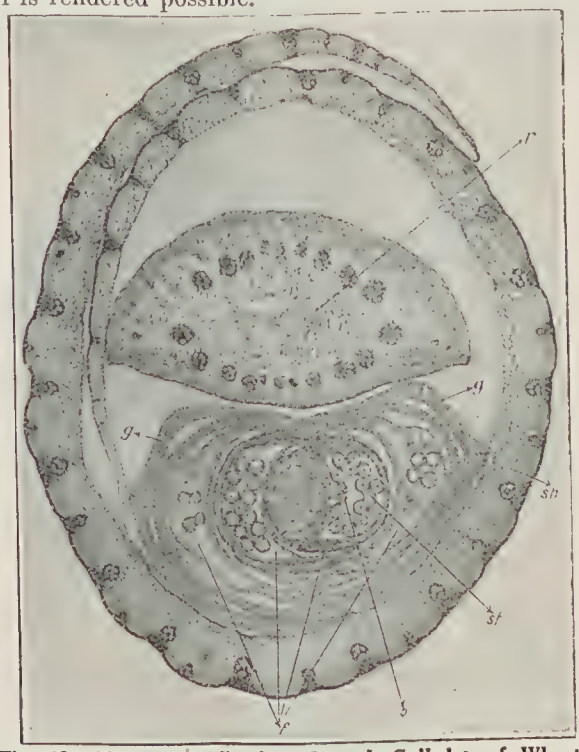

Fig. 13.—Transverse Section through Spikelet of Wheat showing Relation of Parts.

r. Rachis or stem; *f.* Flowers; *st.* Stamen of flower; *o.* Ovary of flower; *g.* Glumes; *sh.* Sheath.

A large number of experiments have been made to determine the amount of water lost by transpiration from the ordinary farm crops. Though the actual amount is very considerable, it is less than would be evaporated from an equal surface of water exposed to the same conditions. The amount of water transpired to produce a unit weight of dry matter is called the transpiration ratio. This ratio is not a constant and definite quantity for any given crop, but varies from season to season, due to natural climatic differences. The average transpiration ratio for wheat at Rutherglen over a period of four years was 380.

The most important external conditions affecting transpiration are (1) temperature; (2) dryness of the atmosphere; (3) air movements; (4) intensity of light; (5) water content of soil.

Usually the rate at which water is transpired closely approximates the amount absorbed by the roots. Frequently the rate of transpiration exceeds that of absorption, and wilting results. This often takes place in a wheat field in early spring when hot winds are prevalent, or when wheat has been thickly sown, or has produced heavy, flaggy growth. Under these circumstances the rate of transpiration exceeds the rate of absorption, and partial desiccation and wilting results.

Practically all the water lost is transpired through the stomata. The condition of the guard cells of the stomata control the amount of stomatal aperture. The more turgid the guard cells, the more they curve away from one another and the wider the aperture, and hence the greater the transpiration. When the guard cells become flaccid they straighten out and close the aperture completely.

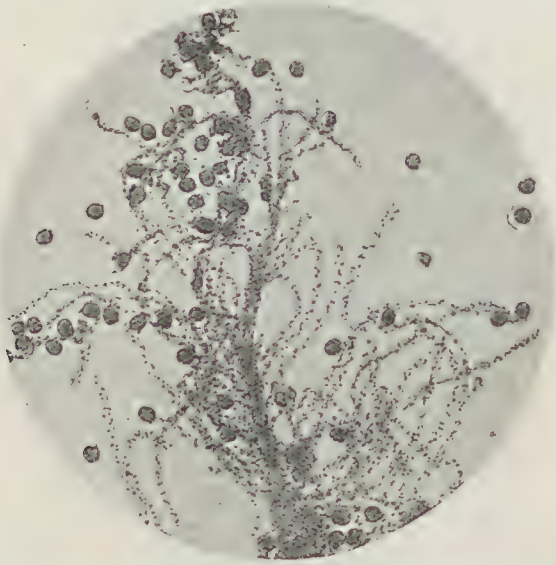

Fig. 14.—Stigma of Wheat Flower, highly magnified, showing numerous adherent Pollen Grains.

4. The Stem.

The stem of the wheat plant is erect and cylindrical, usually from 4 to 6 millimetres wide, and contracted at the nodes, which are solid. The internodes are usually hollow, though in varieties such as Huguenot and Medeah (*T. durum*) the internodes are almost completely filled with soft pith. These are the so-called solid straw varieties. The great majority of the bread wheats are hollow. The stems are completely invested by the leaf sheath, with the exception of the uppermost internode.

The length of the stem varies with the type of wheat. Durum wheats have usually very tall stems. The variety Huguenot—a beardless durum wheat often grown for hay and forage—under favorable conditions will attain a height of 6 feet. Other varieties, particularly certain Indian types (*T. sphærococcum*), possess very short, stiff, upright straw. These varieties are of value for producing, by crossbreeding, new short-strawed types with a high proportion of grain to straw.

The length of stem will, of course, vary with the season and the fertility of the soil in which the wheat is grown. Nitrogenous fertilizers tend to increase the length of the stem and the development of the leaf blades, whilst phosphates tend to reduce the length of stem and increase the proportion of grain. The length of the internodes increases from the base to the apex of the stem.

Tillering.

Wheat, like oats and barley, throws out side shoots after the plumule has appeared above the surface. When grains of wheat are sown, say, 3 inches below the surface, the primary stem of the wheat embryo lengthens into an erect rhizome. The first two or three buds on this rhizome usually remain dormant, whilst the remaining buds and the

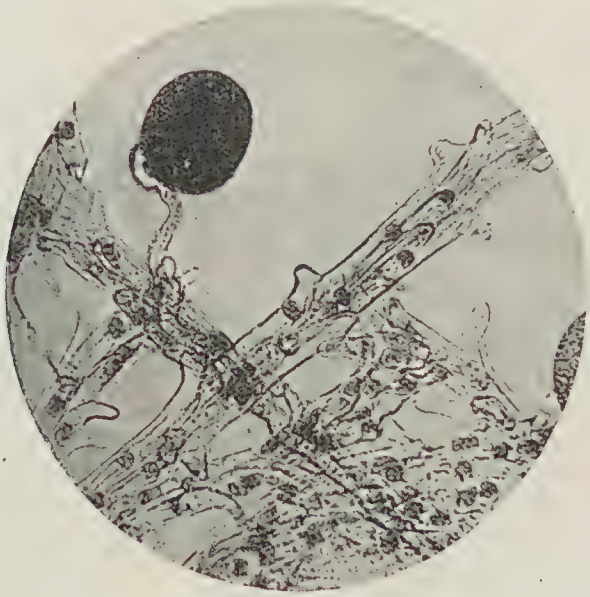

Fig. 15.—Stigma of Wheat Flower, highly magnified, showing Pollen Grain in the Process of Fertilizing the Ovule.

terminal bud produce a strong shoot. During the winter the primary stem grows but slowly, and in the axils of its leaves buds are formed which expand into short secondary stems. These latter bear axillary buds which may develop into other branches. Hence, from the primary bud of a single wheat grain a large number of stems may be produced, which remain very short until spring, when they develop into straws, each with a terminal ear.

Although buds and branches originating during the tillering period may, under favorable circumstances, amount to a large number, unless the plants have ample space for development, and the soil is in a highly fertile condition, they may develop only a few slender straws.

Haberlaut records a case where one grain of wheat produced 130 ears, which produced 6,855 grains of wheat. The conditions under which such a plant developed must have been exceedingly favorable.

On the other hand, the extent to which tillering proceeds under field conditions was determined by Schoute, who found that from an actual

test made of 2,895 plants, 1,845 produced only one straw, 1,035 produced from two six straws, and fifteen produced more than six straws.

The extent of tillering is governed by internal physiological peculiarities of the plants, and also by various external causes. It is dependent on the following factors:—

Species.—Durum wheat (*Triticum durum*), *e.g.,* Medeah and Huguenot, tiller but little; but *Triticum monococcum, T. spelta. T. dicoccum* and *T. Compactum* tiller well.

Variety.—Varieties vary widely in tillering power. Late forms, *e.g.,* Yandilla King and Major, generally tiller well. Early forms, *e.g.,* Bunyip and Sunset, do not tiller well.

Size of Grain.—Percival shows that size of grain influences tillering. Large grains of sixteen varieties of *T. vulgare* averaged 8.1 stems per plant, whilst smaller grains from the same ears yielded only 4.4 stems per plant.

External Conditions.—Profuse tillering is an index of natural vigorous growth, and while, as shown above, it is dependent on the hereditary qualities of the species or variety, it is also dependent on those external conditions which check or assist vegetative growth. The temperature of soil and air, amount and distribution of rainfall, and other climatic factors connoted by "season" have a controlling effect on tillering. Further, the condition of the soil, the amount of available plant food present, the time of sowing, rate of seeding, distance apart of plants, all affect the tillering. Extensive tillering can take place only when each plant has ample room for development. Its roots must be free from competition with the roots of other plants, and allowed to penetrate the soil in all directions if maximum tillering is to be attained.

In Victoria wheat sown early, under favorable conditions, usually tillers well. Late-sown wheat tillers badly. That is one reason why we increase the rate of seeding as the sowing season advances.

Temperature is important, for tillering continues only so long as the temperature is above the minimum for growth, and is most rapid at the optimum temperature.

In the case of rich soil, especially where it is well supplied with available plant food, thin seeding often results in the production of the same number of straws per square yard as that obtained on a thickly-sown field, the tillering process making good the loss of plants which thin seeding entails.

Lodging.

With some crops the lower internodes are too weak to support the weight of flag and ears, with the result that lodging takes place and losses result. The straws become tangled and some ears may lie on the ground, and discoloration and sprouting of grain may result.

If the lodging takes place at an early stage the crop may recover, because, as long as the plants retain their vitality, the ears of the lodged crop will assume an upright position. If lodging takes place at the ripening stage, the nodal tissue may die, and the straws and ears will remain where they are laid.

Lodging usually occurs after heavy rain or strong winds, but the real cause is usually the weakness of the straw, and less frequently a root system which has but little grip on the soil. Some varieties, *e.g.,*

Gluyas, have a weak straw and a naturally drooping habit. Such varieties are liable to lodge with heavy rains and wind at harvest time. Other varieties, *e.g.*, Federation, possess short, stiff straw and are upright in growth. Such varieties rarely lodge. Lodging is more prevalent with thickly-sown crops, caused by drilling seed too heavily and by close sowing and early sowing. The use of nitrogenous manures and stable manure also encourages lodging, because such fertilizers result in vigorous growth and the formation of thin cell walls in the stems of the plants. Varieties which resist lodging have invariably thick lignified cell walls.

Fig. 16.—Head of Wheat Prepared for Crossing.

a. Before treatment.
b. Same head after treatment showing suppression of upper and lower spikelets and portion of median spikelets.

In seasons with mild winters and abundant rainfall, lodging often occurs because such conditions are favorable for luxuriant, sappy growth and weak straw.

Wheat straw contains much silica. Apparently from 60 to 70 per cent. of the ash of wheat straw consists of this ingredient. It was formerly thought that the strength of the straw was associated with high silica content, and it was even suggested that the lodging of wheat might be prevented by the application of soluble silicates to the soil. It was found, however, that the straw of lodged wheat actually contained as much or more silica than that of unlodged wheat. Moreover, Lawes and Gilbert showed that a high percentage of silica in wheat straw was associated with brittleness and weakness, and was an invariable result of bad seasons. Their investigations also showed that well ripened straw of good seasons contained a high proportion of lignified tissues and a low proportion of silica.

5. Inflorescence.

The ear of wheat is called a spike, and consists of a flattened stem or rachis bearing alternately a series of spikelets. These spikelets are sessile, and are borne alternately on opposite side of the rachis.

In wheat there is only one spikelet at each node. The spikes differ in length and degree of compactness. Generally the distribution of the spikelets along the rachis is fairly uniform, but in some varieties, *e.g.*, Clubhead, the spikelets are crowded towards the tip. The density or length of internodes of the spike is an important varietal character. In some varieties, *e.g.*, Indian varieties of *Triticum sphærococcum*, the internodes of the rachis are extremely short and the spikelets closely crowded on the rachis. These are called dense-eared wheats. On the other hand, certain varieties, *e.g.*, Spelt, have very long internodes, with wide distances between each spikelet. Such varieties are lax-eared types.

Each spikelet consists of a fine rachilla, which bears alternate flowers. There are two or more flowers in each spikelet, enclosed by two chaffy glumes. Usually only two or three kernels mature, but in some varieties, and especially in favorable seasons, there may be five or more grains in a spikelet. The glumes in wheat are oval in shape, and the size, form of keel and terminal tooth are constant characters of much value in classification. The glumes may be creamy white, red, or black. They may be pubescent or glabrous.

On opposite sides of the short rachilla are boat-shaped flowering glumes, in the axils of which are the flowers. In bearded wheats long

Fig. 17.—Crossing Wheats at Rutherglen Experiment Farm, 1912.

awns are found on the flowering glumes of all spikelets from the base to the top of the ear. In beardless wheats these awns are reduced to short points. Opposite each flowering glume is the palea, a thin membranous glume the edges of which enclose the flower. At the base of the flowering glume are two thin minute lodicules. According to Percival, they swell greatly at flowering, become more or less spherical, and expose the stamens and stigmas of the flower. Later they collapse and close again.

The flower consists of three stamens and a single carpel. Each stamen consists of a slender stalk, the filament, bearing at its summit

the anther or pollen sacs, which consist of four longitudinal chambers containing large numbers of smooth and almost spherical pollen grains.

The carpel consists of an obovate ovary with a single sessile ovule and two terminal styles which curve outwards when flowering occurs. Each style has a large number of stigmatic branches.

The wheat plant is said to be in flower when the anthers begin to extrude from the glumes.

The development of the carpel and the stamens in the same flower proceeds at the same rates, so that stigmas are ripe or receptive when the pollen is shed.

The flowers at the base of the spike are usually the first to be fertilized, and flowering proceeds from the base to the apex over a period of two to five days.

In order to produce seed, a pollen grain must fall on one of the stigmatic branches, germinate, and push its tube through the centre of the style to the egg cell of the ovule.

The fertilized ovum divides into two cells by a transverse wall, and by continual subdivision forms a mass of cellular tissue which rapidly differentiates into plumule sheath, rudimentary foliage leaves, scutellum, primary root and walls of the ovary. There is a continual increase in the amount of dry matter from the fertilization of the ovum to the ripening.

(To be continued.)

CACAO SHELL—FEED FOR STOCK.

The research chemist employed at Messrs. Cadbury's Bourneville Works has made a study of the waste product cacao shell and has compiled on the subject an interesting little pamphlet which Messrs. Cadbury have now published.

The world production of cacao shell is estimated to be about 36,000 tons a year; of this quantity Europe consumes 22,000 tons and Great Britain about 5,000 tons.

The use to which the stuff is put is principally for incorporation, after being finely ground, in cattle cakes, for which in small quantities it is not unsuitable, as may be seen from the analysis.

The analyst of the Midland Agricultural and Dairy College tested a sample and found it to contain:—Oil, 2.8; albuminoids, 16.9; soluble carbohydrate, 44.9; fibre, 16.4; and ash, 7.7; and remarks: "This substance is rarely met with except as a constituent of compound cakes and meals."

The use made of the shell is another example of the advantage of research work. Here we have a substance which, some years ago, was considered of practically no value, now turned to good account.

DOOKIE CROP COMPETITION, 1923.

Report of the Judge, H. A. Mullett, B.Ag.Sc., Senior Inspector of Agriculture.

During the past eighteen months the Dookie district has witnessed what must lead to a revolution of the farming methods practised on the black flats there. Several farmers were induced to farm their land according to the style proved so successful on similar land in the Wimmera. Thus, fallowing was commenced in March instead of August or even later, the fallows were tilled over frequently with a new type of scarifier, and with cultivators, harrows, &c., whenever necessary to kill weeds and to retain a loose dust mulch. Seeding was not commenced until all rubbish that germinated in the autumn had been killed by cultivation, and it was done late enough to prevent excessive straw development. The rate of seeding was raised from 60 to 75 lbs. per acre, and the dressing of superphosphate from 56 lbs. to at least 1 cwt. and in some cases to 170 lbs. per acre.

Though the season was as unfavorable as could be imagined for a trial of late sowing, the experiment was a remarkable success, as all the crops on black soil so treated have averaged from 42 bushels, when the method was partially used, to 54 bushels where it was adopted in its entirety. All of these crops have completely eclipsed those sown in the usual manner.

It will be remembered that the seeding season opened particularly late, and that once the rains began they continued almost without intermission until early August. Consequently, the crops sown in mid-June and in July, as was advocated, had to face exceptionally cold, wet conditions; nevertheless, the pioneers of the experiment persisted with their efforts. In August the crops were backward, but clean. Early-sown wheat at that time appeared as if it would be superior. The Wimmera-style crops were the subject of derisive comment. However, they continued to make headway, though the spring was not at all favorable to them.

By harvest time they were seen to be free from excessive straw development, very dense, and well headed, and quite free from wild oats and weeds. The harvester has since demonstrated how well they filled the bag.

The rainfall received at Dookie in 1923 is indicated in the following table:—

January	22	points	25 points, Autumn.
February	—	,,	
March	3	,,	
April	—	,,	
May	198	,,	10.46 inches, Winter.
June	479	,,	
July	369	,,	
August	100	,,	4.85 inches, Spring.
September	130	,,	
October	175	,,	
November	80	,,	
December	120	,,	
	16.76 inches		

Thus the wet nature of the winter can be readily imagined.

Harvesting a Heavy Crop of Oats at Mr. P. J. Ryan's, Dookie.

The Competition, 1923.

There were eleven competitors in the section for the best 25 acres of crop. The first prize has been awarded to Messrs. Bennett Bros. for their crop of Wannon wheat, which secured 95 points. Mr. J. Knox was second with his crop of Federation with 91 points, and third with Minister, which was allotted 90 points. Then follow Messrs. Bennett Bros. with 88 points for Federation, and P. J. Ryan with 86 and 83 for Federation and Austan, respectively.

All these were magnificent crops, and their yields were so high that it was a matter of great difficulty to estimate them. Messrs. Bennett Bros. won the Shepparton competition with the fallow upon which their crops were grown, and Mr. Knox won the Dookie competition with his, so that to this extent it was possible to predict a year ahead that better crops than the average would be grown on them.

All these crops were distinguished by the minimum of straw development, almost total absence of weeds, and very densely-packed heads. Most of them stood the stormy weather experienced during the harvest, but Mr. Knox's crop of Minister went down.

In some instances the seed was not as pure as it might have been. The crops of Wannon, Joffre, and Austan shown were comparatively pure. None of the Federation, though obtained direct from a Wimmera seed station, was quite free from strangers, but the crop of this variety shown by Mr. J. Beattie was satisfactory in this respect.

Details of Results.

Section 1.—Best 25 acres Wheat.

Competitor.	Variety.	Soil.	Yield.	Purity.	Absence of—		Even-ness.	Total.
					Weeds.	Disease.		
Possible points..	.. ..	.. ..	**35**	**20**	**15**	**15**	**15**	**100**
Bennett Bros.	Wannon	Black, red patches	35	19	11	15	15	95
J. Knox ..	Federation	,, ,,	34	16	12	15	13	90
J. Knox ..	Minister	Black ..	34	16	15	14	10	89
Bennett Bros.	Federation	Black, red patches	33	16	12	14	13	88
P. J. Ryan	,,	Black ..	31	18	11	11	14	85
P. J. Ryan	Austan ..	,, ..	29	20	10	11	13	83
Bennett Bros.	Joffre ..	Red ..	20	19	14	13	14	80
D. Magennis	Federation	Black ..	25	14	10	11	12	72
J. Beattie ..	,,	Red ..	19	19	11	8	11	68
T. Hume ..	,,	,, ..	16	13	11	13	14	67
L. Sim ..	Major ..	Grey ..	11	13	12	4	11	51

The winning crop of Messrs. Bennett Bros. was grown on black soil treated as follows:—The paddock was summer-fallowed in March with a disc-cultivator to 3 inches deep. In August the land was re-ploughed to 3 inches deep. In September it was harrowed; in October spring-toothed and harrowed. After harvest a stroke of the harrows was given in first week in January, and another in March to fill up cracks which appeared. After rain in May the harrows were again used, then

the paddock was scarified in June and twice harrowed. Seeding commenced in the second week in July; 76 lbs. of graded pedigreed seed were used, with 171 lbs. superphosphate per acre. After the drill two strokes with the harrows were given.

This competitor's crop of Federation was similarly treated, except that it was sown on the 28th June, and that the quantity of seed used per acre was 74 lbs. The Wannon was sown on a portion of the paddock, which had less red patches than where the Federation was sown.

It is rare that crops shown by Mr. J. Knox are beaten in competition. The Minister was a show crop in every respect until after it was ripe, when it went down. For this fault 5 points were deducted. However, with the aid of the header the grain was picked up. There was a complete absence of weeds.

Mr J. Knox's Crop of Minister Wheat.

The Federation was also a fine bulky crop, though an odd wild oat was present, but nothing to speak of. The paddock on which it was grown contained some red land, which reduced the yield somewhat. It is stated to have yielded 52½ bushels per acre. The Minister was grown on well-worked summer fallow, and the Federation on winter fallow. Both were sown late, and a liberal dressing of seed and manure was applied. The summer fallow was ploughed in March to about 5 inches deep (rather deeper than is usual for summer fallow); then the Wimmera-type scarifier was put over the land to kill rubbish as it appeared in July, in August, and in October. In the following March the paddock was harrowed to arrest cracking. In May the land was scarified up and harrowed, then re-scarified in June, drilled 27th June, and harrowed. Seventy-four lbs. of seed was used per acre with 124 lbs. superphosphate. The winter fallow on which the Federation was grown was ploughed in July to 5 inches deep and

harrowed twice in the spring after rain. Subsequently it was treated precisely as the other paddock, except that it was drilled later—between 29th June and 5th July. The same rate of seeding and manure was used.

Mr. P. J. Ryan's crop was sown on winter fallow. This was ploughed in July to 3 inches deep; harrowed in August and again towards the end of September. The paddock was spring-toothed over in October, and a stroke of the harrows was given in December. It was not further cultivated, but was sown with the combined cultivator-drill, commencing 21st June. Eighty lbs. of seed with 93 lbs. of super-phosphate were used. A further harrowing was given after the drill. Some undergrowth was present in this crop. The Austan showed extraordinary development of flag.

Mr. D. Magennis' crop of Federation was a good one, though somewhat uneven. A lack of consolidation of the soil was noticeable,

Mr. J. Knox's Crop of Federation—53 bushels per acre.

apparently due to the fallow having been worked somewhat too deeply towards the end of the season. The wheat, therefore, had a tendency to pull out easily, and probably was troublesome to harvest for this reason.

Reviewing the competition, there is no doubt that the efforts of the society to introduce improved farming methods into their district have been crowned with an immediate success which is little short of remarkable. The demonstration of what can be done to improve the yields of their districts should not be lost on the organized public bodies and on individuals in the Goulburn Valley, of which Dookie is a part. They would be sanguine indeed, however, if they expected such rapid and substantial results as those obtained at Dookie; nevertheless, at least they should be convinced that the results to be got are worth while.

Fallowing Methods.

The success of the summer (fifteen months) fallowed crops on the black flats at Dookie should encourage those who have friable soils in the Goulburn Valley to give the method a trial. Apart altogether

from the enhanced yield that may result, the summer fallowing has many advantages which commend it to practical farmers. There is no better way of cleaning land of weeds. By working up the soil in March a splendid germination of weeds follows the first rains, and these can be killed by cultivation in July and August. They germinate far more freely on the loose soil than in unploughed land, hence more weed seeds can be destroyed in a given time. Then, again, the team work is better distributed, as the heavy work of breaking up the paddock can be done at a time when the horses may be otherwise idle.

The suggestion, however, applies only to soil which can be easily ploughed while dry. For black flats such as exist in parts of the Goulburn Valley, the method is certainly an ideal one that can be adopted at once. On the friable red loams it will require systematic testing.

Mr. J. Beattie's Crop of Federation Wheat.

On the other hand, there is no advantage in breaking up stiff red clays by summer fallowing, nor, indeed, is it feasible. These are best ploughed as soon as possible after the sowing has been finished. Tests at Rutherglen indicate that it is desirable to plough them a full 5 inches where the soil is deep enough. However, it is probably unnecessary and perhaps undesirable to plough any very friable soils in the Goulburn Valley to that depth, owing to the difficulty of setting them down again sufficiently in an 18 to 20 in. rainfall belt.

After the original ploughing has been done, the surface of the fallow should be maintained in a loose condition, with the object of conserving moisture. As weeds appear, they should be cultivated out. All working should be done as far as possible after rain, before the soil dries out. A much better texture is thereby obtained and more moisture conserved. On the stiffer soils, of course, it is undesirable to work the soil so fine that it may be beaten down flat with rain.

Consequently, the working of this particular class of land is a compromise between moisture conservation and maintenance of good texture. Unless the tendency to set after rain can be altered, any improvements in yields are likely to be unsubstantial.

There are two methods by which improvement can be made in texture. One is by the addition of humus in the form of green manure, and the other by the use of soil amendments like lime and gypsum. The first method has been tried at the Research Farm, Werribee, but in ten years, repeated ploughing under of green crops such as peas, rape, &c., on the same land has effected little, if any, improvement in yield. Evidently then the amelioration of soils by green manuring is a slow process, though no one doubts that the incorporation of decayed vegetable and animal matter into the soil as a matter of settled policy should be undertaken whenever possible, except where the presence of disease renders it desirable to destroy crop residues by fire.

With mineral soil amendments, a much more rapid improvement can be looked for, though they are no complete substitute for humus. In the Western Wimmera a substantial benefit has been effected on the soil immediately following upon an application of gypsum. This material is now undergoing test in the Goulburn Valley, and it is thought that it can be demonstrated that a substantial and profitable improvement in texture follows its use. It must be admitted, however, that the results of some tests made this year at Shepparton do not lend much support to the hope, but possibly on soils of somewhat stiffer texture the gypsum will prove itself.

Wheat Diseases.

Ball smut was not much in evidence this year, nor was there much take-all in the Goulburn Valley. However, considerable loss must have resulted from attacks of flag smut. In one crop in the Dookie district a count was made which indicated that the yield had been reduced by one-third, and generally it ranged from 10 to 15 per cent. in the crops inspected. The seriousness of the disease is, however, not realized by many because there is little to show from the attacks save that the crop appears thin, but closer examination shows the blackened, twisted leaves characteristic of the disease, and the number of stools which have failed to form mature heads.

Flag smut is a fungus disease propagated by tiny black seeds called spores. These when germinated cannot live in the absence of a wheat plant in the tissues of which the fungus they give rise to feeds and develops. Finally, the fungus fructifies in the leaves and produces the material which darkens the seed. To keep it in check, it is necessary to destroy the spores before they come into contact with a wheat plant. Hence, all wheat stubbles of infected paddocks should be carefully fired. As far as possible, all that then remains should be turned under with the plough so that it may decay. When paddocks are really badly infected, it is found usually that wheat has been grown too often without resting the land. Here it will be desirable to sow a crop of oats before fallowing and again sowing to wheat. Infected hay should not be fed to horses, as the spores pass through the animal undamaged.

THE TOBACCO INDUSTRY.*

LESSONS FROM AMERICA.

By Temple A. J. Smith, Tobacco Expert.

Fertilizing.

After a careful investigation of the conditions under which tobacco is grown in the United States, I am of opinion that the lines on which Victorian growers can proceed with greatest advantage to themselves and the industry will be in an effort to produce the best types of bright plug-tobacco leaf and cigarette leaf. In order to do this, the very rich river flat lands should not be employed, though I see no reason why the lighter sandy river flats should not produce good tobacco. That much of the land now used can be made to yield better-quality leaf I have no doubt, and I believe that heavy dressings of superphosphate up to 5 cwt. per acre will contribute largely to such a result. This has been found to be the case in every district where tobacco is grown in America, and should be more marked in Australia. It is evident that superphosphate in heavy doses has an effect on the quality of tobacco leaf, apart from its influence on the quantity produced.

From conversations with leading specialists I have gleaned information on this matter which should have far-reaching effects on our tobacco industry. They claim that by using heavy applications the crop can be ripened four weeks earlier, the colour of the leaf made lighter and brighter, and the texture smoother and softer. I saw many tests in this direction being carried on at the State experimental stations, and was much impressed with the results. Leading growers on a large scale substantiate the opinions of the experts in this respect. Australian soils are naturally deficient in phosphoric acid, and consequently should respond well to such treatments.

Improvement of Leaf by Planting Suitable Varieties.

Further improvement can be made in the local leaf by planting suitable varieties in soils best adapted for the growth of certain types of leaf and by planting closer in the rows. I made a selection of such varieties, seed of which I sent to Mr. Marks; the seed has been sown this season at the seed farm, Wahgunyah, and a quantity should be available for distribution to growers next season.

Soils.

In respect to cultivation the best growers in Victoria have little to learn, but in the choice of soils for tobacco of high grade there is much to learn. The best tobaccoes in America are grown on poor sandy soils, naturally well drained, which without heavy applications of fertilizer would not produce any crop profitably. In Victoria we have large areas of land which appear suitable for tobacco of good quality,

* Portion of report of Mr. Temple A. J. Smith, who was commissioned by the Government to visit the United States of America last year to inquire into the most successful methods of cultivating and curing tobacco there.

particularly in the north-east and in north-eastern Gippsland, well back from the coast.

Climatic conditions in the places mentioned more nearly resemble those of Virginia and the Carolinas than other parts of Victoria. The rainfall in the American States is higher than ours, but is too great in some instances, and I learned from the growers that a moderately dry season gave the best results, too much rain causing many diseases which fortunately the Victorian grower is free from. There are other parts of this State, such as the Stawell and Bendigo districts, which, given sufficient rainfall or with irrigation, should produce good leaf, provided soils containing too much chlorine are avoided.

Rotation of Crops.

Rotation cropping, with tobacco as the main money crop, is generally practised, only one tobacco crop being grown in each three-year series, the object being to build up the land in humus without supplying too much nitrogen. This is necessary in America, where the soils are very sandy, and in the majority of cases have been worked for many years to a greater extent than will be the case in Australia for some time to come. Grasses do not come naturally in the tobacco States when the land is spelled as they do here, and special crops have to be grown to supply the losses caused by previous crops. Rotation cropping on our poorer soils will, however, be necessary in the near future to bring about the best results, and I have obtained much information and literature on this subject which will be of value to local growers.

Labour.

Labour in America is more plentiful than here, and a great part is supplied by the coloured population. The bulk of the leaf grown in the south-eastern States is produced on the share system by negroes under the white man's supervision. An average negro family will attend to from 6 to 12 acres. The usual division of the crop is half to the landlord and half to the tenants. Where labour by the day is paid for, 4s. to 5s. is the usual rate, or from 30 to 40 dollars (£6 to £8) per month. The cost of growing, including rent, labour, fertilizer, and all charges, is estimated at from 7d. to 10d. per lb. Negro labour is not very satisfactory, as the coloured man is slipshod in methods of cultivation and many other ways, and few raise tobacco without the white man's supervision.

Prices for bright leaf range from 3d. to 2s., the average being about 10d. to 1s. 3d., and the tobacco farmer in recent years has made very little money. I had many opportunities of meeting farmers, and spent much time in discussing their problems with them, and the general feeling was that since 1920 prices had barely allowed a profit.

Grading and Marketing.

The system of marketing on the open floor appears to be a very crude one. The leaf when ready is brought into the huge warehouses in small lots of from 25 to 500 lbs. placed on the floor in heaps or on trays and sold by auction. This continues day after day for months, and much time in marketing seems wasted under this system.

The growers have apparently no say in regard to price, but have to take the best offer. In the past much dissatisfaction has been found with the system, and during the last three years huge farmers' co-operative associations have been formed, through which members pool their tobacco, have it graded and prepared for market, and sold as required. It is claimed that prices have been increased from 25 to 50 per cent. in this way. About 65 per cent. of the growers have joined the associations, which they claim are growing stronger each year. It is apparently not etiquette for manufacturers or dealers to buy privately from growers, all sales being made either on the open market or through the associations.

The American tobacco-grower certainly understands grading his leaf better than the Australian; and, perhaps, the marketing of the leaf in the manner described has had much to do with teaching him this process, as he is able so see how each individual grower prepares his leaf for market, and thus learns the requirements of the buyers and the best way in which to both grade and tie up his tobacco. Each class of tobacco is graded by farmers into five or six grades, and each grade is sold separately. The dealers who buy and regrade make as many as fifty grades of the various classes, re-dry, and sometimes strip the leaf and pack it in hogsheads or tierces holding from 1,000 to 1,200 lbs. each, in which the tobacco is shipped to any part of the world.

A system of marketing Victorian tobacco where growers could meet to see each parcel sold would be very educational in respect to grading and preparation of their leaf, and such a system should easily be inaugurated at some of the central railway towns in tobacco-growing districts. I believe that Victorian buyers would readily fall in with this idea. There is some poor-quality tobacco grown in America, but a market can be found for all kinds (the inferior being sold to the negroes and others), which is not so much the case in Australia, consequently the Australian grower will need to be the more particular to produce a larger proportion of high-class leaf. On the whole, too, it appeared to me that the Australian-manufactured tobacco was quite equal to if not better than the average American sold.

I had the opportunity of seeing over some of the large tobacco factories, one of which employs 1,500 hands (mostly coloured people), and turns out 167 tierces (83 tons) of tobacco per day. I also spent a considerable time in several of the largest rehandling factories in Virginia, North and South Carolina, and Kentucky, where regrading the leaf and preparing it for shipment overseas was completed. I am of opinion that in the near future regrading of Victorian leaf will have to be done at the selling warehouses, as the many classes of leaf at present grown make it impossible for local growers to grade evenly. In America, after generations of experience, farmers' tobacco is regraded by dealers in the rehandling establishments, and this in spite of the fact that whole counties are devoted to the production of one type of leaf, a stage not yet reached in Victoria.

Samples of Victorian tobacco leaf and cigarettes met with the dealers' approval, and surprise was expressed that such good leaf had been grown without fertilizer, and the opinion given that such tobacco would sell well on the American markets.

Diseases.

Wherever possible I made special inquiry into the questions of diseases in relation to tobacco, and, with the exception of blue mould, Victoria is remarkably free from troubles of this kind. Wild Fire, Angular Leaf Spot, Black Schank, Mosaic, Frenching, Wilt, Root Rot, and many others, together with insect pests, cause much loss and labour in the States. I had the privilege of meeting several specialists who devote their whole time to investigation of individual diseases. Dr. Tisdale, of Florida, who has had some experience of Blue Mould, is of opinion that the surest way to combat this trouble is by selection and development of resistant types. He gave me valuable information and literature on the subject. Dr. Valeau, of Lexington, Kentucky, also gave me much information on other diseases, and strongly recommended great care in the importation of seed, and suggested that it would be better, once suitable varieties had been proved, to grow our own seed to avoid the risk of introducing diseases. This is already being done at the Government Nursery, Wahgunyah, to some extent.

I visited Messrs. Slater, of the Slater Seed Company, Boston, Va., and T. Wood and Sons, seedsmen, of Richmond, and sent out to Victoria some seed of selected varieties, and arranged for consignments, if necessary, from these firms in the future. Several of the specialists in diseases have promised also to send me seed of disease-proof plants, as they procure them. I made a collection of literature on all subjects pertaining to tobacco, its culture, handling, marketing, diseases, &c., which I brought with me.

Flue-curing.

Most of my time was spent in the districts where flue-curing was practised, and I was able, by visiting the early districts first, to work back from Georgia to Virginia, and get much experience on this phase of the industry. Though I learned a great deal that will be useful, I have concluded that Victorian growers will have to evolve a system to suit local conditions. The principles of flue-curing are the same, but the difference in climate, especially humidity, and in the lighter types of leaf generally grown make it impossible to follow exactly on American lines. Victorian growers have already made great progress in curing, but are inclined to place their tobacco too thickly in the barns and to hurry the process of curing in their anxiety to make one barn do the work of two.

The types of barns used in Victoria are quite as good or better in plan and construction than those in America, which are mostly made of logs mudded up, with poor arrangements for ventilation. The usual heating is done by one stove, but a strong tendency to use double furnaces extending well into the centre of the barn is being shown by progressive men.

Places Visited.

During my stay in America I visited the States of Virginia, North and South Carolina, Georgia, Florida, Kentucky, Indiana, and Ohio. In the first four States flue-curing is general, and there the best pipe

and cigarette tobaccoes are produced. In the three latter, all the tobacco is air-cured, a process our buyers do not favour; also much of the Kentucky leaf is used for chewing purposes, and this special type is overproduced to such an extent that growers are seriously thinking of cutting out one year's crop to reduce the surplus.

Cigar Leaf.

The cigar-leaf growers in Florida are reducing their plantations, as the crop is not profitable, and cigar-smoking is said to be on the decrease as compared with the smoking of cigarette and pipe tobaccoes. From investigation of cigar-leaf production, I do not think Victoria can or will produce cigar leaf as well as the northern States, such as Queensland, chiefly for climatic reasons. The market also in Australia for cigar leaf is limited, and the prospects of the cigarette and pipe tobaccoes for Victoria are more likely to be fulfilled.

Conclusion.

I feel sure as a result of my investigations that there is much room in Victoria for expansion of the tobacco industry, particularly on both sides of the Dividing Range in the north-east. It is not as a rule wise to grow within 40 miles of the coast, but there is probably some 400,000 or 500,000 acres in Victoria capable of producing good tobacco leaf. In regard to present prices and yields for local tobacco, our growers are receiving good value as compared with those in America, and I am confident that the next five years will see a considerable expansion of the industry and much improvement in the quality of the locally-grown tobacco.

During my stay in America six progress reports on tobacco were forwarded to the Department of Agriculture, and three on cotton. These are being published, and give details of the processes adopted in the United States. I am glad to acknowledge the great kindness received from the Secretary of Agriculture, Mr. Wallace; Dr. W. A. Cobb, Dr. Taylor, Dr. Lewis, Dr. Valcan, Professor Kinney, Dr. Tisdale, Mr. E. G. Moss, Director of Experimental Farm, Oxford, N.C.; Mr. S. S. Star, Director of Coastal Plain Farm; T. F. Copley, Chatham Experimental Farm; Messrs. J. C. Hart, Tobacco Expert; G. Burrell, Tobacco Expert, and many others who so readily provided me with information and assisted to make my visit a pleasant one.

I would like to take this opportunity of expressing my gratitude to the members of the Government and the Director of Agriculture for giving me the opportunity of visiting America. I believe that it will result in a very considerable improvement in tobacco culture in this State within the next few years. Having seen the types of soils growing the different classes of tobacco for special purposes, the varieties used, and the treatments adopted, I am in a better position to advise growers, especially in new districts, and in many other ways assist the industry, and though I realize it will take some time to induce growers to grow on lighter soils and use heavy dressings of fertilizer, I feel sure that such practises must come eventually.

THE VALUE OF A BULL.

Ascertainable only by Testing his Progeny.

J. S. McFadzean, Senior Dairy Supervisor.

There were very few people who had heard of the Jersey bull, Skim of Dunalister 1227, prior to his daughters in the Warenda stud, owned by Mr. Thos. Mesley, at Dalyston, having shown by their heavy yields that they were of exceptional dairy value. Now every one interested in Victorian herd test Jerseys knows that he was a particularly valuable sire, whose capability to reproduce high dairy quality in his heifers had been made very small use of. In fact, he was so little thought of that, until then, no one had troubled to register him as a pedigreed animal, and the date of his birth had been forgotten.

Bred by Mr. D. Peters, in his Dunalister stud, at Essendon, Skim was born about 1910, being so named because he was raised on skim milk alone, and did well on it. When something over a year old, he was sold for fifteen guineas to Mr. William Woodmason, owner of the Melrose stud, who took him only because he had no bull at the time. Just after the Royal Show of 1913, he was sold to Mr. J. Brough Smyth, of Loch, and used in his Luscombe stud until his clearing sale in 1916, when Skim was bought by Mr. D. E. Cook. His pure-bred heifers were bought by Mr. E. Hayes, of Archie's Creek, who later on sold them to Mr. Thos. Mesley. In 1920, Mr. Cook sold Skim to Mr. E. W. Hartnell, of Poowong, who resold him in 1922 to Mr. Davenport. He, finding the bull's further usefulness as a sire was doubtful, sold him for £1 to be slaughtered, and so ended the career of what we now know to have been a valuable stud animal.

Skim of Dunalister was sired by the Werribee bred bull Clementine 2nd's Beau (240), bred by Mr. G. T. Chirnside, from imported stock, and it is worthy of note that those of his heifers which gave best results also show by their pedigree that they are descended from three other bulls imported by Mr. Geo. T. Chirnside, viz., Belteshazzar (6), Brighton King (100), and Cherry's Pride (375), while two other imported bulls, Progress III. and Laddie Fowler (454), also appear in the pedigrees of two of the dams.

Of fourteen pedigreed daughters sired by Skim, those which remain in Mr. Mesley's hands have made the best showing, although the thirteen tested have made the splendid average of 7,159 lbs. of milk and 394.34 lbs. of butter-fat in 273 days. Amongst Mr. Mesley's are three of Skim's daughters with yields of over 500 lbs. of butter-fat in nine months' milking, Garenne 2nd giving 581.34 lbs., Keynote 537.05 lbs., and Gazelle 2nd 513.67 lbs. of butter-fat in the 273 days' test. As these outstanding cows were sired by Skim within the three years he was in the Luscombe herd, it is certain that if he had been in a big herd where the best use could have been made of him for his whole life, it would have been of much benefit to the State.

Another instance of the value of a bull being discovered by chance was that of Audrey's Lord Twylish (985), also bred by Mr. Chirnside.

Bought by Mr. R. G. Keys, and used in his Holmwood Jersey stud, at Dandenong, Audrey's Lord Twylish sired some exceptionally good milking cattle. Mr. Keys was dairying, but he did not test his stock for their individual production, consequently when he sold off his stud the cattle found buyers on their appearance alone, the owner missing the increased prices which they would have brought had their high dairy quality been then known. After the sale, daughters of Audrey's Lord Twylish were tested in other studs, and his progeny having proved their high quality in the show-ring also, there has been a wonderful demand for his stock. This famous bull is now dead, but fortunately for the dairying industry, he passed his life in two good herds, and sired a great number of heavy producing stock.

Photo supplied by Mr. T. Mesley.

Skim of Dunalister 1227 (bred by Mr. D. Peters, of Dunalister) by Clementine 2nd's Beau 240 (bred by Mr. Chirnside from his imported stock).

Sire of	Garenne 2nd	581 lbs.	butter fat in	273	days.
,,	Keynote	537	,,	,,	,,
,,	Gazelle 2nd	513	,,	,,	,,
,,	La Charme	480	,,	,,	,,
,,	Pibroch	469	,,	,,	,,
,,	Phillis of Luscombe ..	421	,,	,,	,,

(Average for six cows, 500·16 lbs.)

Only by herd testing can the true value of a stud sire be ascertained. In the absence of herd testing, many a good bull has passed through the hands of both dairymen and stud owners without his true worth being known. What an owner may thus lose by not testing can only be conjectured. Certainly the men who do test are those who make the best of their opportunities. There can be nothing lost by trying out the true dairy quality of the breeding stock, and there are very many instances indeed to show that there is much profit to be made from so doing.

STANDARD HERD TEST.

Report for Quarter ended 31st December, 1923.

The cows which completed the term during the quarter number 228, of which 162 qualified for certificates.

Owner.	Breed.	No. completed Test.	No. Certificated.	Name of Cow.	Herd Book No.	Date of Calving.	Days in Test.	Milk last Day of Test.	Milk.	Average Test.	Butter Fat.	Standard required.	Estimated Butter.	Previous Butter Fat Records in lbs.
								lbs.	lbs.		lbs.	lbs.	lbs.	
Mrs. F. M. Akehurst, Tunstall	Jersey ..	3	Nil											
H. Allez, Echuca West	Friesian	1	1	St. Alban's Witch	653	15.1.23	273	20	6,541	3·36	220·22	175	251	
The Alston Estate, Cobram	Jersey ..	3	3	Annie G. of Tarnpirr ..	6022	8.2.23	273	17½	6,215	5·90	366·29	250	417½	284, 339
				Pigeon of Kameruka ..	6035	19.2.23	273	21½	7,793	6·13	477·86	250	541½	384, 356, 409, 398
				Regina of Tarnpirr ..	10128	1.3.23	273	21	6,193	6·80	421·38	250	480½	253, 336
J. Anderson, junior, Lyndhurst	Jersey ..	1	1	Canary 12th of King's Vale ..	10130	21.1.23	273	29	8,757	5·36	469·34	200	535	404
W. K. Atkinson, Swan Hill	Shorthorn	2	2	Blanche Rose 10th	10892	10.2.23	181	32	8,694	3·83	332·58	250	379¼	296, 402, 423, 405, 397
				Morven Queenie 9th ..	10896	19.2.23	273	30½	8,794	3·96	348·19	250	397	280, 335, 352, 332
W. A. Axford, Camperdown	Jersey ..	2	2	Monitress of Rockbank ..	11414	1.3.23	273	18½	5,993	5·48	318·63	175	363½	
				Butterfly of Titanga ..	9370	2.3.23	273	16½	6,371	4·41	280·98	250	320¼	
A. E. Batson, Buckley	Jersey ..	1	1	Daphne 2nd of Somerset ..	9193	21.2.23	273	10	3,459	5·99	207·24	175	236½	
F. W. Beischer, Bendigo	Jersey ..	2	2	Tragedy of Linden	7537	31.1.23	268	4	6,852	5·08	347·91	250	396¾	
				Blossom of Woodside ..	6391	9.2.23	259	4	5,250	5.92	310·96	250	354½	

STANDARD HERD TEST—*continued*

Owner.	Breed.	No. completed Test.	No. Certificated.	Name of Cow.	Herd Book No.	Date of Calving.	Days in Test.	Milk last Day of Test.	Milk.	Average Test.	Butter Fat.	Standard required.	Estimated Butter.	Previous Butter Fat Records in lbs.
								lbs.	lbs.		lbs.	lbs.	lbs.	
Mrs. Agnes Black, Noorat	Jersey ..	3	2	Noorat Marguerite ..	6413	26.2.23	261*	29	6,418	4·20	269·44	250	307¼	211, 357, 388, 378
				Noorat Flashlight 2nd ..	6411	11.3.23	273	17	6,092	5·10	310·62	250	354	222, 249
Callery Brothers, Bannockburn	Ayrshire	3	2	Alma of Langley Park ..	3477	14.1.23	273	17	8,668	4·19	363·49	250	414½	290, 326, 350, 270
				Stella of Langley Park ..	8558	22.3.23	273	16	6,248	4·44	277·38	175	316¼	
Dr. S. S. Cameron, Hawthorn	Jersey ..	1	1	Duke's Spark of Glen Iris ..	12881	2.3.23	273	5½	3,745	6·51	243·95	200	278	199
R. C. Campbell, Clarendon	Jersey ..	1	Nil											
Mrs. M. E. Carroll, Tyntynder Central	Red Poll	1	Nil											
P. Chirnside, Oakleigh	Jersey ..	3	3	Werribee Northwood Madeira 6th	6540	11.1.23	273	21	6,208	5·92	367·53	250	419	426, 412, 393
				Canary 5th of Lesterfield ..	12163	15.3.23	273	23	5,369	6·00	321·89	175	367	
				Canary 4th of Lesterfield ..	10267	19.3.23	273	21	6,461	5·92	382·75	200	436¼	274
Clyne Brothers, Tinimba	Jersey ..	8	2	Dunalister Garantie ..	10371	27.12.22	273	16	5,040	5·29	266·76	250	304	
				Dunalister Perree's Jersey Maid	10414	27.3.23	273	10	4,976	5·04	250·76	250	285¾	
Cockbill and Gibbs, Rockbank	Ayrshire	16	Nil											

* Died before completing full term.

Standard Herd Test—*continued.*

Owner.	Breed.	No. completed Test.	No. Certificated.	Name of Cow.	Herd Book No.	Date of Calving.	Days in Test.	Milk last Day of Test.	Milk.	Average Test.	Butter Fat.	Standard required.	Estimated Butter.	Previous Butter Fat Records in lbs.
								lbs.	lbs.		lbs.	lbs.	lbs.	
E. A. Dennis, Swanpool	Jersey ..	1	1	Royal Sun Ray	9710	19.3.23	273	18½	7,224	4·98	359·63	250	410	339, 287
Department of Agriculture	Red Poll	7	6	Avesia	287B	17.1.23	273	14	8,161	4·25	346·90	250	395½	280, 335, 309, 440, 304, 411
				Laodicea	306B	21.1.23	273	25	7,732	4·17	322·64	250	367¾	212, 245
				Queen Elizabeth	400C	24.1.23	273	19½	10,204	4·19	427·20	250	487	300, 428
				Birdseye	377C	16.2.23	242*	18½	6,256	5·22	326·45	250	327¼	250, 341, 438, 486, 392, 360, 488, 213, 459, 315
				Sovereign	320B	24.2.23	273	26½	5,991	4·61	276·23	250	315	263, 302
				Bahama	238A	28.2.23	273	14½	5,745	4·27	245·37	200	279¾	294
	Jersey ..	2	2	Victoria Beauteous ..	10198	17.10.22	273	8	4,245	6·40	271·88	175	310	
				Victoria Attraction ..	10197	14.11.22	273	5½	3,991	5·76	230·07	200	262½	296
	Friesian	4	3	Dominion Belle Corona ..	369	24.1.23	273	37½	10,799	3·54	382·03	250	435¼	305, 420, 400, 338
				Dominion Kathleen ..	378	25.1.23	253*	13	8,774	3·42	300·72	250	342⅝	451
				Victoria Coriander	992	23.3.23	273	12½	5,630	3·46	194·89	200	222¼	
C. Deverell, Wangaratta	Jersey ..	4	4	Una of Wooringa	12175	22.2.23	273	16½	5,666	6·40	362·76	175	413½	
				Minuet of Banyule	6075	1.3.23	273	31	8,471	5·63	476·30	250	553	
				Ixia of Springhurst ..	5397	12.3.23	273	29	9,886	4.73	467·28	250	532⅜	311, 328
				Arcadias Princess of Methven	12173	21.3.23	273	21½	6,294	6·07	382·09	175	435½	
P. J. Ducat, Shepparton	Jersey ..	4	3	Myrtle 2nd of Jersey Vale ..	7222	15.2.23	273	14½	4,986	5·51	275·05	250	313¾	190, 203
				Duchess of Goulburn ..	9162	15.2.23	273	20	6,266	5·62	351·99	250	401½	
				Buttercup of Airlie ..	10203	28.2.23	273	13½	4,080	7·01	285·95	175	326	

* Withdrawn before completing full term.

STANDARD HERD TEST—*continued.*

Owner.	Breed.	No. completed Test.	No. Certificated.	Name of Cow.	Herd Book No.	Date of Calving.	Days in Test.	Milk last Day of Test.	Milk.	Average Test.	Butter Fat.	Standard required.	Estimated Butter.	Previous Butter Fat Records in lbs.
								lbs.	lbs.		lbs.	lbs.	lbs.	
C. Falkenberg, Elliminyt	Jersey ..	2	Nil											
R. Faragher, Koroit	Jersey ..	1	1	Clover of Mona Bank ..	11400	4.3.23	273	13½	4,175	5·64	235·44	175	268½	
R. Ferguson, Riddell	Ayrshire	1	Nil											
	Friesian	1	1	Duchess of Hanover 2nd of Berry	214	25.2.23	273	8	7,022	3·94	276·53	250	315¼	255
W. Fixter, Boisdale	Jersey ..	1	1	Beauty's Daffodil of Lesterfield	10265	19.2.23	273	28	8,238	5·12	422·07	250	481¼	304, 208, 364
Flack and Sewell, Berwick— "Burnbank" Herd	Friesian	5	4	Dominion Fobes of Yarra Brae	266	6.1.23	273	24	10,184	3·42	348·59	250	397½	281, 312
				Dutch Girl of Berry ..	141	9.1.23	273	6	6,809	3·78	257·09	250	293	313
				Springfield Lady 2nd ..	1109	24.1.23	273	22½	8,150	3·65	297·13	175	338¾	
				Burnbank Mercedes Maggie ..	1081	23.2.23	273	26½	15,184	3·38	513·96	200	586	307
"Arblair" Herd	Friesian	4	4	Burnbank Woodcrest Fayne	414	26.12.22	273	10½	7,836	3·44	269·80	200	307½	
				Lady Segis Galatea Van Racelands	204	27.12.22	273	22½	9,052	3·09	280·02	250	319¼	
				Rosevale Cordele Posch ..	1378	30.12.22	273	41½	12,720	2·92	371·19	175	423¼	
				Dominion Homestead Maggie	259	1.3.23	273	37½	16,562	3·26	540·54	250	616½	330, 373, 316
With A. V. Becker, Welshpool	Friesian	1	Nil											
M. and W. A. Francis, Kilcunda	Ayrshire	1	Nil											

STANDARD HERD TEST—*continued.*

Owner.	Breed.	No. completed Test.	No. Certificated.	Name of Cow.	Herd Book No.	Date of Calving.	Days in Test.	Milk last Day of Test.	Milk.	Average Test.	Butter Fat.	Standard required.	Estimated Butter.	Previous Butter Fat Records in lbs.
								lbs.	lbs.		lbs.	lbs.	lbs.	
G. Gange, Mininera	Ayrshire	1	Nil											
Geelong Harbor Trust, Marshall-town	Ayrshire	9	7	Daisy of Sparrovale ..	3888	30.12.22	273	14	6,314	4·66	294·51	250	335¾	290, 317, 298
				Annie Laurie of Sparrovale ..	9091	31.12.22	273	15	5,982	4·24	254·40	175	290	
				Viola of Sparrovale ..	3908	15.1.23	273	22	9,742	4·70	458·26	250	522½	352, 434
				Nora of Sparrovale ..	7316	27.1.23	273	14½	6,110	4·37	266·82	200	304½	254
				Duchess of Sparrovale ..	3889	28.2.23	258	4	6,567	4·13	271·12	250	308¾	261, 275, 297, 271
				Jewell of Sparrovale ..	7314	3.3.23	273	9	5,077	4·46	226·32	200	258	
				Mabel of Sparrovale ..	7315	4.3.23	273	13	6,153	4·19	258·17	200	294¼	256
H. S. Gibson, Murray-dale	Ayrshire	2	2	Dorrie of Evergreen ..	7318	26.12.22	273	6½	5,520	4·34	239·48	200	273	254
				Mischief of Evergreen ..	9119	24.2.23	273	15½	7,103	3·79	269·12	175	306¾	
R. Goodman, Kil-many South	Ayrshire	3	2	Floss of Roseneath ..	7333	18.3.23	273	10	4,939	4·13	204·10	175	232¾	
				Flora Again of Roseneath ..	7330	18.3.23	273	4	4,200	4·81	202·11	200	230½	167
O. G. Handbury, Toora	Jersey ..	1	1	Lassie of Strathbow ..	12205	21.2.23	273	23	4,666	5·09	237·43	175	270¾	
W. Henderson, Gras-mere	Ayrshire	9	1	Prue 4th of Carracoorte ..	9431	11.3.23	273	19	4,514	4·61	206·22	175	235	
R. J. Henry, Euroa	Jersey ..	1	1	Antonette of Hill Crest ..	9448	13.2.23	273	20½	5,882	4·97	292·30	250	333¼	
J. A. Huffer, Gorman-dale	Jersey ..	1	1	Dunalister Mannikin's Czarina	10384	26.2.23	273	16	4,413	5·52	243·71	200	277¾	

STANDARD HERD TEST—*continued.*

Owner.	Breed.	No. completed Test.	No. Certificated.	Name of Cow.	Herd Book No.	Date of Calving.	Days in Test.	Milk last Day of Test.	Milk.	Average Test.	Butter Fat.	Standard required.	Estimated Butter.	Previous Butter Fat Records in lbs.
								lbs.	lbs.		lbs.	lbs.	lbs.	
J. Hutchinson, Somerville ..	Jersey ..	3	3	Kenta of Somerville ..	6946	24.1.23	229*	19	6,194	5·58	345·52	250	394	
				Babs of Somerville	9412	8.2.23	273	40½	11,185	5·16	577·62	200	658½	347
				Beauty 4th of Somerville ..	6945	8.2.23	273	35	10,481	5·27	552·05	250	629¼	504, 543, 475
A. W. Jones, Whittington, near Geelong	Friesian	6	6	Gaiety of Craigneil	1035	30.12.22	273	23	9,000	4·00	359·71	200	410	300
				Carlyle Duchess	1227	30.12.22	273	19	6,470	3·92	253·81	175	289½	
				Waituki Princess Abigail ..	1023	26.1.23	273	24½	11,114	2·98	332·12	250	378¾	272, 305
				Buttermaid 2nd	1024	27.2.23	273	19½	8,748	3·65	319·05	250	363¾	311, 442
				Cordyline Inka de Kol ..	1028	8.3.23	273	18	11,355	3·98	451·84	250	515	282, 401
				Westmere Inka Pietertje ..	1032	14.3.23	273	19½	9,641	4·03	388·90	200	443¼	348
	Jersey ..	4	4	Fuchsia of St. Albans ..	13209	3.1.23	273	23	7,283	5·13	373·47	200	426	328
				Junette of Hillcrest ..	7037	1.2.23	273	14½	5,222	5·64	294·44	250	339¾	
				Blanchette 5th of St. Albans..	10272	12.2.23	273	20	6,788	5·10	345·94	200	394½	283
				Butter Queen 2nd of Meryula	9736	27.2.23	273	18	7,337	5·30	389·15	250	443¾	292, 272
E. Talbot Jones, Clematis	Friesian	1	Nil											
A. Joshua, Berwick	Jersey ..	1	1	Silver Daisy of Terara ..	9445	27.12.22	273	8½	4,502	6·43	289·48	200	330	298
Kerr Brothers, Bacchus Marsh	Shorthorn	3	1	Morven Lizzie 15th ..	Not yet allotted	5.1.23	273	13	5,430	4·52	235·28	175	268¼	
C. Lees, Lockington	Ayrshire	7	6	Aspect of Gleneira	9730	19.1.23	273	4	6,968	4·27	297·40	250	339	290
				Hope of Range View ..	5453	19.1.23	273	21	7,237	4·04	292·71	250	336¾	
				Snowdrift of Gleneira ..	9750	22.1.23	273	20½	8,340	4·34	362·02	250	412¾	322
				Pansy of Gleneira	8464	16.2.23	273	7	5,821	4·50	261·81	200	298¼	281
				Nestle of Gleneira	6149	20.2.23	273	9	6,369	4·54	288·95	250	339½	339
				Sunny 2nd of Gleneira ..	3453	4.3.23	246	4	6,132	4·52	277·07	250	315¾	265

* Sold before completing full term.

Standard Herd Test—*continued.*

Owner.	Breed.	No. completed Test.	No. Certificated.	Name of Cow.	Herd Book No.	Date of Calving.	Days in Test.	Milk last Day of Test.	Milk.	Average Test.	Butter Fat.	Standard required.	Estimated Butter.	Previous Butter Fat Records in lbs.
								lbs.	lbs.		lbs.	lbs.	lbs.	
Mrs. E. M. Lennie, Tongala	Jersey ..	4	4	Show Girl of Tarnpirr ..	10311	7.1.23	273	20½	7,328	5·36	392·54	200	447½	346
				Sweet Nell of Hillcrest ..	6019	12.1.23	273	28	9,862	4·94	476·92	250	534½	303, 505
				Tulip 5th of Bonshaw ..	7104	3.2.23	273	16	7,768	4·43	344·10	250	392¼	237, 235, 366
				Starbright of Lynroy ..	9759	14.3.23	273	18½	6,715	5·07	340·49	250	388	365
Agricultural High School, Leongatha	Jersey ..	2	1	Alice of Woorayl	9559	4.2.23	273	21	6,717	6·12	411·10	250	468¾	315, 308, 384, 293
C. D. Lloyd, Narrewarren	Jersey ..	1	1	Rye Gold Duchess of Glen Iris	11566	17.1.23	253*	10	3,604	5·96	214·69	175	244¼	
H. Luxton, Whittlesea	Jersey ..	3	3	Sunbeam of Somerville ..	9418	11.1.23	273	18	6,805	5·67	385·61	200	439½	307
				Mary Anne of Banyule ..	6072	24.1.23	273	20	7,461	5·21	389·03	250	443½	334, 441, 426
				Wagga Harmony	6730	3.2.23	273	16½	4,433	5·64	250·09	250	285	
C. G. Lyon, Heidelberg	Jersey ..	2	2	Silvermine 14th of Banyule ..	5220	2.2.23	273	31	9,864	4·70	464·97	250	530	300, 383, 445, 376
				Magnet's Lass 7th	11590	16.3.23	273	17	5,073	5·50	279·18	175	318¼	
C. W. W. Macaulay, Rochester	Jersey ..	1	1	Rosebud of Taranah ..	11630	21.2.23	273	12	4,092	5·71	233·51	175	266¼	
L. McFarlane, Bundoora	Ayrshire	6	4	Primrose of Ayrbrae ..	7564	28.12.22	239	6	5,731	4·70	269·42	200	307¼	222
				Beryl of Ayrbrae	7560	7.1.23	266	5	6,938	4·32	299·82	200	342	
				Mulberry 2nd of Ayrbrae ..	7563	24.1.23	232	6½	5,516	4·27	235·73	200	268¾	248
				Mermaid of Ayrbrae ..	9969	1.3.23	273	23	6,192	4·62	286·38	175	326½	
K. McGarvie, Pomborneit	Jersey ..	1	1	Music of Greenwood ..	10332	3.3.23	273	17	4,756	4·57	217·50	175	248	

* Withdrawn before completing full test.

Standard Herd Test—*continued.*

Owner.	Breed.	No. completed Test.	No. Certificated.	Name of Cow.	Herd Book No.	Date of Calving.	Days in Test.	Milk last Day of Test.	Milk.	Average Test.	Butter Fat.	Standard required.	Estimated Butter.	Previous Butter Fat Records in lbs.
								lbs.	lbs.		lbs.	lbs.	lbs.	
W. J. McKernan, Tatura	Ayrshire	1	1	Princess of Locheden ..	10016	26.12.22	273	16	6,739	3·81	256·36	175	292¼	
R. Maher, Tongala	Jersey ..	3	3	Gem of Hillcrest	9605	26.2.23	273	17	6,302	4·01	252·72	250	288	
				Star of Hillcrest	10471	7.3.23	266	8	4,654	4·25	195·70	175	223	
				Daphne of Welbourne ..	10467	8.3.23	273	20	5,374	5·10	274·04	250	312½	
E. J. Moore, Cowes	Jersey ..	1	1	White Bell of Rochdale ..	9795	19.3.23	273	17½	4,434	4·60	203·74	200	232½	226
W. Muhlebach, Batesford	Ayrshire	1	1	Mermaid of Retreat	4334	27.3.23	137*	26½	5,517	4·77	263·21	250	300	305, 394
Mrs. E. O'Donohue, Kilmore	Ayrshire	1	1	Blanche of Lowlands ..	11286	21.3.23	273	13	4,496	4·38	197·06	175	224¾	
T. H. Payne, Kilmore	Red Poll	2	1	Plumstead Permain ..	219AA	13.3.23	273	14½	6,755	4·40	297·05	250	338¾	273
D. Peter, Mornington	Jersey ..	1	1	Dunallster Perree's Capture ..	10410	12.2.23	273	21	7,135	5·50	392·53	250	447½	
J. Plattfuss, Tongala	Friesian	1	1	Monovale Juno Paxton ..	169	25.1.23	273	35½	15,369	3·65	544·87	250	621½	326, 388

* Sold before completing full term.

Standard Herd Test—*continued.*

Owner.	Breed.	No. completed Test.	No. Certificated.	Name of Cow.	Herd Book No.	Date of Calving.	Days in Test.	Milk last Day of Test.	Milk.	Average Test.	Butter Fat.	Standard required.	Estimated Butter.	Previous Butter Fat Records in lbs.
								lbs.	lbs.		lbs.	lbs.	lbs.	
R. Purnell, Moriac	Jersey ..	2	1	Woodruff Mystic Maid ...	10517	2.2.23	273	12	3,120	6·72	209·77	200	239¼	
J. D. Read, Springhurst	Jersey ..	9	9	Tulip 2nd of Springhurst ..	9667	22.1.23	267	14½	4,638	6·00	278·14	200	317	316
				Chrysanthemum of Springhurst	12214	13.3.23	273	20½	6,330	4·89	309·73	175	353	
				Heather of Springhurst ..	12218	16.3.23	271	13	4,026	6·00	241·82	175	275⅜	
				Polygold of Springhurst ..	12221	18.3.23	269	10½	3,773	5·69	214·64	175	244⅜	
				Tecoma of Springhurst ..	12225	22.3.23	273	21½	5,804	4·96	287·67	175	328	
				Lucerne of Springhurst ..	5399	22.3.23	273	16	6,163	5·70	351·12	250	400½	305, 334, 286, 349
				Dianthus of Springhurst ..	12215	22.3.23	273	15	4,580	5·98	273·93	175	312½	
				Fern of Springhurst ..	10443	24.3.23	273	23	6,340	5·73	363·06	200	413⅜	278
				Boree of Springhurst ..	9661	26.3.23	273	16	6,987	5·30	370·65	200	422½	279
Miss Bruce Reid, Bundoora	Jersey ..	2	2	Jubilee Musk	10455	2.1.23	267*	17	5,572	4·43	246·79	200	281½	136
				Jubilee Wallflower	12228	5.2.23	233*	16½	3,898	5·22	203·36	175	231¾	
Miss Robinson, East Malvern	Jersey ..	2	2	Kyora Defender's May 3rd ..	7380	2.1.23	273	20	5,112	5·12	261·91	250	298½	255, 212, 263
				Bonnie Doon's Pride ..	7377	6.3.23	273	14½	4,881	5·78	281·98	250	321½	254, 247
G. Rowe, Kardella	Jersey ..	2	Nil											
Agricultural High School, Sale	Ayrshire	4	1	Madge of La Trobe ..	11362	29.12.22	273	16½	4,468	4·01	179·22	175	204¼	
A. H. Schier, Kernot	Ayrshire	12	6	Fine Quality of Gleneira ..	7711	17.1.23	273	14	5,442	4·82	262·26	250	299	187, 209
				Bettsie of Inverleigh ..	10285	24.1.23	273	17	5,554	4·36	242·33	200	276½	213
				Scotswood Sylvia	10321	2.2.23	273	23½	5,072	4·19	212·75	175	242½	
				Scotswood Mayflower ..	10305	10.2.23	273	17½	4,500	4·03	181·55	175	207	
				Merline of Inverleigh ..	11363	15.2.23	273	14½	4,704	4·64	218·19	200	248¾	196
				Modesty of Inverleigh ..	5861	17.2.23	273	16	6,329	4·09	258·73	250	295	223, 247

* Sold before completing full term.

Standard Herd Test—*continued.*

Owner.	Breed.	No. completed Test.	No. Certificated.	Name of Cow.	Herd Book No.	Date of Calving.	Days in Test.	Milk last Day of Test.	Milk.	Average Test.	Butter Fat.	Standard required.	Estimated Butter.	Previous Butter Fat Records in lbs.
								lbs.	lbs.		lbs.	lbs.	lbs.	
J. Scott, Heidelberg	Jersey ..	4	4	Laurel of Springhurst ..	7329	4.1.23	273	12½	5,346	5·56	297·28	250	339	
				Maitland's Petal 2nd of Havilah	5211	15.1.23	273	14½	4,257	5·96	253·73	250	289½	326, 295
				Lady Jacqueline	5359	21.1.23	273	19	5,621	5·16	289·81	250	330½	217
				Irish Eyes of Elonera ..	9699	17.4.23	273	13	4,544	6·30	286·17	200	326¼	236
O. J. Syme, Macedon	Friesian	2	2	Jennie de Kol	301	27.2.23	273	32½	11,516	3·70	423·94	250	483½	348, 400, 319, 368
				Burnside Korndyke Riverdale	1224	13.3.23	273	42	13,586	2·89	393·22	250	448¾	
W. Tendeson, Lilydale	Jersey ..	3	3	Lady Choice of Tarnpirr ..	5160	28.2.23	273	10	7,789	5·62	438·49	250	500	494, 474, 376, 464
				Guinea Gold of Brookside	9721	28.2.23	273	10	7,683	4·23	324·98	250	370½	343
				My Luck of Tarnpirr ..	11718	1.3.23	273	15	6,732	5·83	392·72	200	447¾	344
L. W. Thompson, Pakenham	Jersey ..	2	2	Gaiety Girl 12th of Melrose ..	12247	9.3.23	273	13	4,166	5·91	246·09	175	280½	
				Pearl 12th of Melrose ..	12249	20.3.23	273	14½	4,753	5·74	272·97	175	311¼	
J. Thorburn, Woodend North	Ayrshire	1	Nil											
T. Trevaskis, Tongala	Jersey ..	1	1	Joy Bell of Ballara ..	11721	12.1.23	273	11	3,932	6·30	247·62	175	282¼	
J. T. Tweddle, Sunbury	Friesian	2	2	Ashlynn 25	1076	3.1.23	259	12	7,190	3·65	252·17	250	287½	292
				Cluny Hengerveld Vernon 2nd	3905	23.2.23	273	23	7,703	3·46	267·37	250	305	
A. L. Walter, Little River	Jersey ..	1	1	Bonnie 2nd of Tarnpirr ..	7052	24.2.23*	263	6½	4,027	6·90	278·71	250	317¾	387
Agricultural High School, Warragul	Red Poll	1	1	Nyanza	373B	13.3.23	255	4	6,642	4·24	281·59	250	321	256, 260†

* Entry deferred three weeks because of mammitis. † A 176 days' test.

STANDARD HERD TEST—*continued.*

Owner.	Breed.	No. completed Test.	No. Certificated.	Name of Cow.	Herd Book No.	Date of Calving.	Days in Test.	Milk last Day of Test.	Milk.	Average Test.	Butter Fat.	Standard required.	Estimated Butter.	Previous Butter Fat Records in lbs.
								lbs.	lbs.		lbs.	lbs.	lbs.	
W. Woodmason, Oakleigh	Jersey ..	10	10	Jenny Lind 9th of Melrose ..	5543	24.1.23	273	16½	5,722	6·09	348·63	250	397½	347, 391, 397, 424, 417, 396
				Graceful Duchess 11th of Melrose No. 1	6981	25.1.23	273	23	7,253	5·88	425·77	250	485½	370, 538, 506, 460, 433
				Graceful Duchess 19th of Melrose	7540	26.1.23	273	22½	6,752	6·41	432·75	250	493¼	325, 404, 438
				Daisy 14th of Melrose ..	10518	8.2.23	273	12½	4,957	5·89	291·85	200	332⅜	279
				Fuchsia 17th of Melrose ..	12246	16.2.23	261*	13	4,032	5·95	239·89	175	273¾	
				Laura 14th of Melrose ..	12248	24.2.23	258*	14½	4,084	6·62	268·24	175	305¾	
				Laura 9th of Melrose ..	5551	24.2.23	255*	16	5,557	5·87	326·48	250	372½	343, 392, 365, 434, 409, 406
				Empire 6th of Melrose ..	5534	24.2.23	255*	19	6,344	5·49	348·33	250	397	441, 480, 487, 356
				Jessie 21st of Melrose ..	9885	26.2.23	252*	20½	6,004	5·81	348·81	250	397⅜	348
				Empire 7th of Melrose ..	10519	6.3.23	245*	12½	4,405	6·11	269·09	200	306¼	

* Sold before completing full term.

DRY-MEAL HOPPERS FOR PIGS.

What may be termed the self-feeding of dry meal to pigs is a question that is receiving considerable attention at present, and hence certain results obtained, and reasons for adopting this method on a commercial scale, may be of some interest. This article has reference to a commercial herd of some sixty sows, all the progeny of which are kept on the farm, and fattened for a co-operative bacon factory.

The herd was started in 1920 by a Danish bailiff, to be run on Danish lines. Good farrowing and fattening sties were built, but the pigs did not do as well as might have been expected. The experiment was tried of running pigs in the store stage out in orchards, which was an improvement. Then the sows with their litters were run in orchards, which was another improvement—scour in the piglings, which had been a source of trouble, becoming very much less prevalent. The pigs in the fattening sties, although well fed three times a day and kept scrupulously clean, did not thrive as they might have done, and the net result was that the pigs, weighing about 16 stone alive, averaged nearly nine months old when ready for the factory.

Experiment with Store Pigs.—It was while seeking for improvements that papers by Professor Evvard, of Iowa, U.S.A., were obtained, at the end of 1921, describing the remarkable results achieved by self-feeding pigs, and allowing them their choice of carbohydrates and albuminoids. It was therefore decided to try the method on a bunch of young stores running out. A self-feeder was improvised out of an old sheep hay rack, by fixing flat galvanized iron sheets inside the V rods, and cutting holes at the bottom for the meal to run through into the trough. The hopper thus contrived was divided transversely into half-a-dozen different compartments, and a different feed placed in each, in order to see which the pigs preferred. The results were as follows:—

31 store pigs, weighing from 6 to 8 stone each, live weight, ate in 7 days:—

Mixed meal (maize, wheat, and barley, ground together in equal proportions)	49 stone
Rice meal	22 „
Fish meal	8 „
Palm kernel cake	5 „
Whole peas (soaked)	10 „
Whole maize	4 „

Average, 6 lb. per pig per day.
Nutritive ratio, albuminoids to carbohydrates, 4.7.

It will be noticed that the pigs rationed themselves very well, but that they were not keen on palm kernel cake. The hoppers were always kept full, except those containing whole soaked peas and maize, as the pigs ate these as quickly as they were put in. They were therefore discontinued after two days.

The pigs obviously ate too much at first, but as they got used to self-feeding the consumption dropped, and after a short time they were only averaging $4\frac{3}{4}$ lb. per pig per day.

On various occasions the amount of meal consumed by bunches of pigs has been weighed before being put into the hoppers, with the following results:—

No. of Stores.	*Average Live Weight. Stones.*	*Meal per Pig per Day. lb.*	*Period of Weighing Meal.*
35	9	4.7	3 weeks
20	9	4.8	1 „
20	9	4.75	2 „
15	8	4.8	1 „
17	6	4.1	2 „
18	6	4.2	3 „

Before dry feeding was adopted, the pigs were allowed a ration of 4½ lb. per day, and as much green stuff and roots as they would eat. The all-round improvement in their condition after being dry fed for some weeks was very marked, particularly among the smaller pigs, which now got all the meal they wanted, and were not thrust aside by the larger ones.

Fattening Experiment.—An experiment was then carried out in the fattening pens, where there were facilities for weighing the pigs. A bunch of 12 stores was divided as nearly as possible into two equal lots: one lot was dry fed, and the other lot slop fed three times a day, with as much food as they would clear up. The period of the experiment was six weeks, and the following were the results:—

	6 Pigs on Wet Food.	*6 Pigs on Dry Food.*
Original weight	51 stone 4 lb.	51 stone 1 lb.
Final weight	78 „ 1 „	87 „ 11 „
Meal consumed	116 „	151 „
Meal consumed per lb. live weight gained	4.4 lb.	4.1 lb.
Average daily gain per pig	1½ lb.	2 lb.

The stores had been used to slop feed when the test began.

This test was enough to show that, taking into consideration the great saving in labour, dry feeding was likely to be a paying proposition, and double dry feeders were installed in every other partition between the sties. These were roughly constructed as shown in the cross section, the sides of the hopper being made of flat galvanized iron. The length is 3 feet, which is found to be ample for two pigs to feed simultaneously on either side.

Sows and Litters.—Dry feeders were now tried with great success for the sows and litters, and the result has been that the sows milk better, the little pigs never suffer from scour, and there are no difficulties at weaning time, as they start eating the dry meal, which is always sweet, and carry straight on with it after weaning without the usual set-back.

Stores.—For a month after weaning the stores are dry fed in orchards, and several advantages are noticeable, the most important of which is that no matter how many are run together, they all get an equal chance. After this stage they are usually folded on vetches, kale or roots, and are not dry fed, but have soaked whole maize and beans thrown to them, in order to make them live chiefly on the green food. At about 9 stone live weight they go to the fattening sties, where they are again put on dry food, and a constant supply of green stuff or roots, which is most important. Of course the pigs must always have water,

and a very interesting point is that the amount of water consumed in the fattening pens is now only half of what it was under the slop system of feeding.

Fig. 1.—Dry Meal Self-feeder in Use.

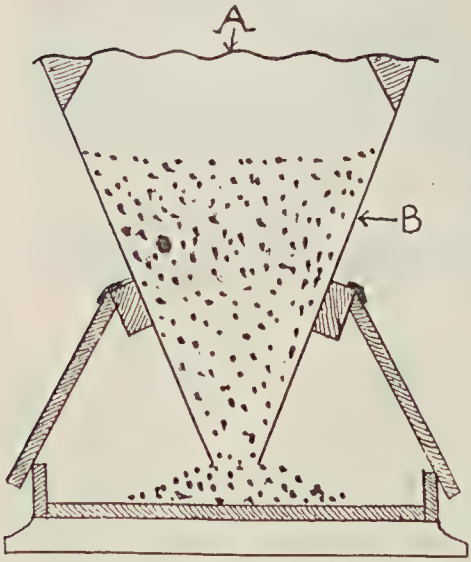

Fig. 2.—Cross-section of Feeder shown in Fig. 1.

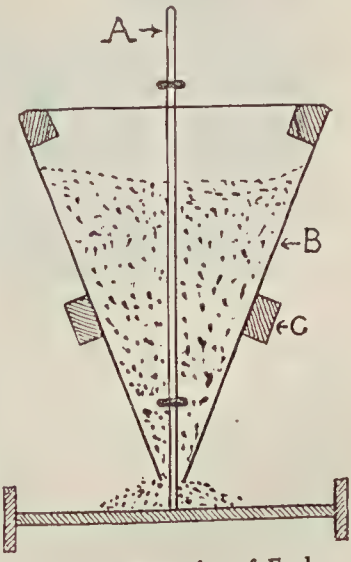

Fig. 3.—Cross-section of Feeder in Sty.

A. Iron railing dividing the sties.
B. Galvanized iron sheeting.
C. Tongued and grooved board ends.

In-Pig Sows.—An experiment has been made with success in dry feeding the in-pig sows. It was found that by feeding only palm kernel cake and fish meal, neither of which is very palatable, with green stuff,

the sows did not get too fat, but kept in nice breeding condition, only consuming about 5 lb. of meal per head per day.

As this is purely a commercial farm, there has not been time or opportunity for a number of interesting experiments which might have been carried out, but the main result of dry feeding has been that the average age of the bacon pig has been reduced from 9 months to 7 months and a substantial saving in meal and a great saving in labour have been effected.

For outside use it was found that a door over the food troughs was necessary, in order to prevent the meal from being blown away and to keep out birds and vermin. At first a vertical swing door that pushed inwards was adopted, but it was found that the pig usually took a mouthful of meal, withdrew its head to chew it, and dropped a certain amount on the ground. Lift-up flap doors were then adopted with great success. The pig has to nose up the door, which rests on its head, and does not withdraw until it has finished feeding, thus entirely eliminating waste.

One difficulty with self-feeding is the cost of the feeders, most of those on the market costing over £10 apiece. The one shown in the photograph was home made, but farmers who have no facilities for making them may purchase well-made feeders to take four pigs at a time for the very reasonable sum of £2 19s. 6d. each.

There is little doubt that self-feeding pigs has come to stay, as by this method the pig is correctly fed, little and often, all pigs get the same opportunity, and there is a large saving in the labour bill; also the difficulty of properly rationing the pigs is eliminated with the self-choice system, as the pigs ration themselves.

[From the *Journal of the Ministry of Agriculture* (Great Britain), Dec., 1922.]

POULTRY IN THE ORCHARD.

By W. C. Rugg, Chief Poultry Expert.

Orchardists are slow to realize that a considerable increase in their income could be obtained by running poultry amongst their trees. Not only is there a good profit to be made out of the eggs, but healthier trees will be developed as a result of the manuring and the continual working of the soil by the birds in their endless search for those insects and grubs, which, in most cases, are very good for the birds but very bad for the orchardist.

Especially in the northern parts of Victoria, poultry-rearing can be made a profitable adjunct to citrus-growing. One of the best flocks of leghorns I inspected during a recent visit to the Mildura district was that raised by Mr. A. J. Hill, of Irymple, who has the birds running amongst his orange trees, in which they roost at night. This flock has never been housed. The poultry pens consist of wire netting yards enclosing six or eight well-grown orange trees, which provide ideal shelter from the sun during the long hot summer, and although the hens eat the leaves for about 12 inches from the ground, this is an advantage,

as it allows the breeze to blow through in hot weather. The soil under and around the trees does not require any working or manuring, as the birds do all this while scratching for exercise.

Mr. Hill started poultry-rearing about four years ago, and is gradually building up a hard, profitable flock. He bred about 1,700 chicks last year. He takes his chickens from the heated brooders at six weeks old and places them in cold brooders made from two kerosene boxes nailed together on the flat with the middle partition knocked out. The top is removed and a piece of corrugated iron put on long enough to lap over each end, the corrugations providing the ventilation. A piece is cut out of one end to allow the chicks to run in and out. They are kept in these boxes for about a week and then they are all shifted at night and placed under the tree on which it is desired they should roost. About a week after that the iron is removed from the top of the brooder; after a couple of nights a few leave the brooder; their example is quickly followed, and by the time the young birds are eight or ten weeks old, all make their roost on the tree.

White Leghorns in Mr. Hill's Citrus Grove at Irymple.

Mr. Hill gives his birds only plain food—nothing forcing—and they mature gradually, early-hatched pullets laying at about five and a-half months, September-hatched ones at about six and a-half months. It is surprising that although sometimes the birds are exposed to rain day and night for forty-eight hours or longer at a time, the best layers are not affected in any way, and the others very little. They are hardy, and well able to rough it.

Mr. Hill traps his pullets for the first four months, and I inspected his scores for the 122 days. The six best pullets laid 95, 98, 100, 100, 103, 104 respectively, which must be considered very satisfactory.

This system of poultry-keeping has much to recommend it in districts with a similar climate.

Mr. Hill's team now competing at the Burnley Competition were reared under the above conditions, and up to the time they arrived at Burnley did not know what a house was. They have laid very consistently, are in splendid condition, and occupy a forward position in their section.

CLEAN MILK.

In order to obtain clean milk an expensive outfit is not necessary, but careful methods are essential. Some simple means of ensuring milk having a low bacterial content, and thus good keeping qualities, are mentioned herewith.

(1) The use of the covered top milk-bucket.—This top is made separate from the bucket, and fits in on the shoulder; being loose it is easily cleaned. By use of such a cover, dust, dirt, and hair from the cow's flanks cannot gain access to the milk.

(2) Four folds of butter muslin should be used to cover the top of the vat. These folds may be held in position with four pegs. The muslin can be easily cleaned and boiled. A covered top and efficient strainer answers the same purpose.

(3) Cooling and aerating are essential. These operations must not be carried out in the shed, but in a detached dust-proof room.

(4) Butter muslin covering the mouth of the can will prevent dirt, flies, &c., gaining access to the finished product.

(5) Iron frames do not absorb splashed milk, and are easily cleaned. Therefore, only utensils fitted with such frames should be used.

ORCHARD AND GARDEN NOTES.

E. E. Pescott, F.L.S., Pomologist.

The Orchard.

Green Manures.

If a cover crop of leguminous plants is required for green manuring a start at planting may now be made. This can be done only when all the fruit has been gathered from the trees. An early crop is a distinct advantage. The cover crop should make a good growth before the winter sets in, as the plants make very little headway in the cold weather, and they require to be ploughed in as soon as the ground is dry enough in early spring. It will thus be seen that it is necessary to get a good autumn growth, as dense as possible, and one which will adequately cover the surface before winter.

Cultivation.

Should the weather remain hot and dry it will be very necessary to give the land surface a good stirring, so as to conserve water supplies Where fruit crops have been gathered a start may be made late in the month with the autumn ploughing; whatever ploughing is done should be left as rough as possible.

Pests.

No codlin moth-affected or diseased fruit of any kind should be left on the ground after the crop has been gathered. These should all be destroyed by boiling.

All rust-affected foliage and fruit of plum and peach trees, as well as all other stone fruits that have been attacked by this and other fungus diseases, such as shot-hole, &c., should be burned if possible. This will minimize the possibility of future attacks.

The Vegetable Garden.

Autumn weeds must be kept out of the kitchen garden. These rapidly grow, and remain as robbers right through until the spring time.

The section should be well dug over for planting winter crops. Before digging a light sprinkling of bonedust and a good top dressing of stable manure should be spread on the surface. These may then be dug in, as they provide humus for the soil. Large plots should be avoided in winter; where such occur a path should be run down the centre. This will provide more efficient drainage. The beds, too, may be more raised than in the summer time.

Early onions may be planted out in the beds, and, if not already done, onion seed should be planted at once.

All classes of seedlings may be planted out, and seeds of lettuce, early peas, beet, carrots, radish, cabbage, cauliflower, and swede turnip may be sown.

Asparagus beds should be cleaned up and cut down as soon as the berries begin to colour. Celery rows should be kept earthed up. rhubarb beds should be given a dressing of manure to encourage the coming winter crop, and new rhubarb plantations may now be established.

The Flower Garden.

All classes of spring-flowering bulbs may now be planted. In bulb planting the bulbs should not come in contact with any manure. The manure should, some time previously, have been dug well in, and mixed with the soil, and all heat should have disappeared. If manure is required it should be placed below the bulb, so that the roots may ultimately penetrate to it. Bulbs thrive in sandy soils, and where the soil is heavy a little sand may be added to advantage. Bulbs should not be planted too deeply; the depth to plant is generally regulated by the size of the bulb. Such bulbs as freesias may be covered with only an inch of soil, while larger bulbs may be somewhat deeper.

The increasing prevalence of both bulb mite and rhizoctinia fungus in attacking bulbs makes it a matter of urgency that all bulb gardens and plots should be well dressed with lime before the bulbs are planted. The lime should be dug into the soil; and after the bulbs have been planted, a top-dressing should also be given. Each dressing need not exceed 2 ozs. per square yard. Clifts's manurial insecticide is also good.

Dahlias and chrysanthemums may be fed with liquid manure, or mulched with stable or poultry manure. In any case the feeding should not be too strong nor too frequent, and it should always be withheld before the flowers come.

All hardy annual, biennial, and perennial seeds may now be planted. Among these are dianthus, candytuft, sweet peas, Iceland poppies, anemone, ranunculus, stock, wallflower, columbine, foxglove. phlox, penstemon, pansy, gaillardia, &c.

Wherever aphis and red spider occur the plants should be sprayed with benzole emulsion, nicotine, pestend, or soaperine, or some other preventive in order to protect the coming flowers. Mildew attacks on the rose should be warded off by the use of sulphur. The sulphur may be either dusted on the plant or it may be scattered on the ground around and under the plant.

March is one of the best months for transplanting evergreen plants of all classes, trees, shrubs, and palms. The roots of the transplanted plants should be disturbed as little as possible, while the roots of those transplanted from pots should be well uncoiled and set out before planting.

The soil is now warm, and the roots will quickly take hold and grow. They are thus established for the winter, and will give little or no trouble in the subsequent summer heat and dryness.

In preparing the soil for planting the trees care should be taken not to dig small holes. A small hole is simply a "pot hole," in which the winter water accumulates, and as a result the young tree roots are rotted.

A large hole should be dug; or better still, the whole planting area should be well cultivated all over, and the plants or trees then set out in this cultivated area.

REMINDERS FOR APRIL.

LIVE STOCK.

Horses.—Those stabled should be fed liberally. Food of a more stimulating nature can now be given to get them well over the "changing coat" season. Those doing fast or heavy work should be clipped; if not wholly, then trace high. The legs should not be clipped. Those not rugged on coming into the stable at night sweating freely should be wiped down and in half-an-hour's time rugged or covered with bags until the coat is dry. Yearling colts if vigorous and well grown may be castrated. Weaned foals should have a little crushed oats daily, if available. Horses to be turned out during winter should not be clipped. Their mouths and feet should be examined and attended to where necessary.

Cattle.—As the nights become colder the dairy cows should be rugged. The rugs should be removed in day-time when the shade temperature reaches 60 degrees. If new grass is plentiful, give a ration of hay or straw, whole or chaffed, to counteract the purging effects of young grass. It will be found profitable to give a few pounds of bran, crushed oats or pollymeal in addition to other food to all cows giving a fair quality of milk. Algerian oats should be sown on suitable land for grazing off in the winter. Sow a mixture of oats, rye, and tares or peas for winter fodder or to fill silos. Irrigated lucerne may be scarified in autumn, Algerian oats sown, and in this way good feed provided for cows in winter. Only exceptional cows or those required for city milk supply should be served between now and July. Within the next two or three months is the best time for cows to calve, as they will pay to feed through the winter, give the best returns for the season, and be dry when the feed is dry and at its worst. Calves should have lucerne hay or crushed oats when grass is not plentiful. Take care that salt lick previously recommended is available. One or two pounds of linseed cake or meal given daily should be found beneficial. In addition to its feed value, the oil in the cake or meal will counteract the effect of dry feed, which is liable to cause impaction.

Pigs.—Sows not already served should be put to the boar. Supply all pigs with plenty of bedding, and see that sties are warm and well ventilated. Supply sows liberally with grain. Castrate young boars as early as possible. Pigs should be highly profitable now, as pork is very dear. Rape, barley (especially skinless), oats, &c., may be sown for grazing during winter.

Sheep.—Merino and fine cross ewes, if mated early, will lamb from now on. Those in lamb to the larger British breeds of rams can be expected to give a certain amount of trouble in lambing.

Close attention should be given morning and evening to save every lamb possible, and pick up any ewes that may be cast. If the ewes are well-woolled sorts, they will need crutching, at the same time clear wool from around teats, and from the eyes. If the ewes are attentive mothers, any lambs that are found dead after these precautions, apart from weather conditions, foxes, &c., are just as well gone. Give purgative drenches at first sight of ewes appearing ill in any way. Give warm salad oil to any lambs that appear ailing. Ewes after difficult parturition or retention of after-birth can often be saved by flushing out with ½ oz. Lysol to 3 pints warm water. Reserve fresh pasture, or better still, sow a mixed green crop to turn ewes into later on, but not while carrying the lambs, this is too often injurious. On fine mornings when attending ewes, if feed is plentiful and ewes strong castrate as many ram lambs as possible, they are easily caught when two or three days old. Place them between the feet on the ground, no holder is necessary. In districts where conditions make second dipping a necessity, see that it is done before the weather becomes too unsettled.

There is now sufficient growth of wool to class sheep; any inferior in fleece, and light cutters, should be taken out and fattened while prices are high.

Poultry.—Do not feed maize this month—soft food aids moult; add a teaspoonful of linseed to each bird's ration once daily. The more exercise the hens get the better they moult. Add to drinking water one packet of Epsom salts to twenty birds. Keep a sharp look out for chicken pox. Forward pullets should now be in their winter quarters, with plenty of scratching litter, and fed liberally—including ration of animal food. Grit, shell, and charcoal should always be available.

CULTIVATION.

Farm.—Dig potatoes as they mature. Cart out and spread stable manure. Finish preparation of land for main cereal crops. Sow Chou Moellier seed in beds for transplanting. Sow the following mixture per acre for green feed during the winter months for the dairy herd:—1½ bushels, Oats; ½ bushel, Cape Barley; ½ bushel, Tick Beans; ½ bushel, Pease. Sow Giant Drumhead Cabbage for transplanting (1 lb. sufficient for 1 acre, in rows 3 feet apart); provided the soil is in good friable condition, plants from seed sown last month should be planted out. Sow wheat and oats according to locality; also rape for winter feed or green manuring. Prepare clean seed-bed for lucerne; and sow Hunter River, Arabian, or Peruvian seed, free from dodder, in drills 7 inches apart and at the rate of 12-16 lbs. of seed per acre. Sow permanent pastures with grasses and clovers.

Vineyard.—Examine "Yema" grafts to see if strings require cutting. Consideration must be given to manuring; early application is strongly urged. Peas, &c., for green manuring should be sown as soon as possible.

Cellars.—Cleanliness is emphatically urged. Carefully remove all fermentable refuse—skins, lees, skimmings, &c. Such odds and ends favour multiplication of Vinegar Flies (*Drosophila funebris*). If present, destroy these with formalin or insecticide powders. A little bisulphite or sulphurous acid in washing water is recommended; also free use of lime on floors, &c.

Orchard.—Prepare land for planting; plough deeply and sub-soil. Plant legumes for green manure. Plant out strawberries. Clean up Codlin Moth from trees as soon as all fruit is gathered.

Flower Garden.—Plant out evergreen shrubs, trees, and Australian plants, divisions of herbaceous plants, seedlings, layers, and rooted cuttings. Feed chrysanthemums with liquid manure weekly until flowers begin to open. Prepare land for future plantings of roses and shrubs. Keep dahlias tied to stakes.

Vegetable Garden.—Plant out seedlings from the seed beds. Dig all vacant spaces roughly. Sow onions for early crop; also peas and broad beans. Clean out asparagus beds wherever the seeds are ripening.

Poultry.—Do not feed maize this month—soft food aids moult; add a teaspoonful of linseed to each bird's ration once daily. The more exercise the hens get the better they moult. Add to drinking water one packet of Epsom salts to twenty birds. Keep a sharp look out for chicken pox. Forward pullets should now be in their winter quarters, with plenty of scratching litter, and fed liberally—including ration of animal food. Grit, shell, and charcoal should always be available.

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GREEN FEED FOR WINTER

WINTER FODDER CROPS

Somner's Special Mixtures

No. 1—Rye, Dun Peas, Golden Tares (Vetches), Barley or White Oats, mixed quantity, sufficient for 1 acre - - - - - - 15/6

(Five-acre lots, **14/6** per acre).

No. 2—Oats, Cape Barley, Golden Tares, Tick or Horse Beans, Partridge, Dun, or Blue Peas, mixed quantity, sufficient for 1 acre - - 18/6

(Five-acre lots, **17/6** per acre).

Either of these mixtures, if cut or pastured in Winter and ploughed under in August, will make a good preparation for Lucerne to be sown in August or September.

The growing of Summer Fodder Crops imposes a tax on the resources of the soil, and as a restorative when ploughed in, the above mixtures are specially recommended. The crop comes away rapidly and makes steady headway during Winter, giving a good quantity of excellent fodder.

Somner's Giant Kangaroo

— RAPE —

(We are the original Introducers)

A highly nutritious and palatable green feed. **Will fatten 3 more sheep per acre than any other kind. Will not taint the milk.** Sow 4 to 6 lbs. per acre in drills, or 8 to 12 lbs. broadcast. 1/- lb.; 100/- cwt.

DWARF ESSEX RAPE

English Grown (true) 9d. lb.; 80/- cwt.
N.Z. Grown, 8d. lb.; 70/- cwt.
Dutch Grown, 8d. lb.; 70/- cwt.

Egyptian or Berseem

CLOVER

The Great Winter Fodder

Valuable for its green or dried fodder, and as a Winter Soiling Crop for Orchards, Vineyards, &c., on irrigated land. At least four cuttings can be made during a season. Sow 8 to 12 lbs. per acre in drills, or 20 to 30 lbs. broadcast.

"Misskawi" Brand (Imported direct), specially re-machine cleaned, 1/9 lb.; 1/8 lb. in 14 lb. lots; 1/7 lb. in 28 lb. lots or more.

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The leading Agricultural Seed House in Victoria

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PEARL BARLEY MILLERS
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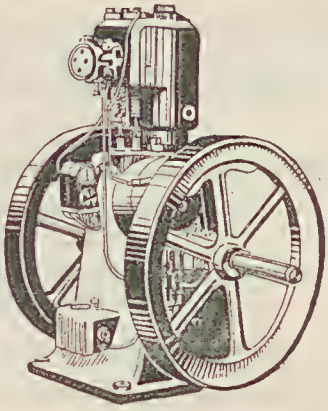

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If your needs are satisfied with the ordinary horizontal hopper cooled engine you can buy nothing better than the MITCHELL. Both are Guaranteed.

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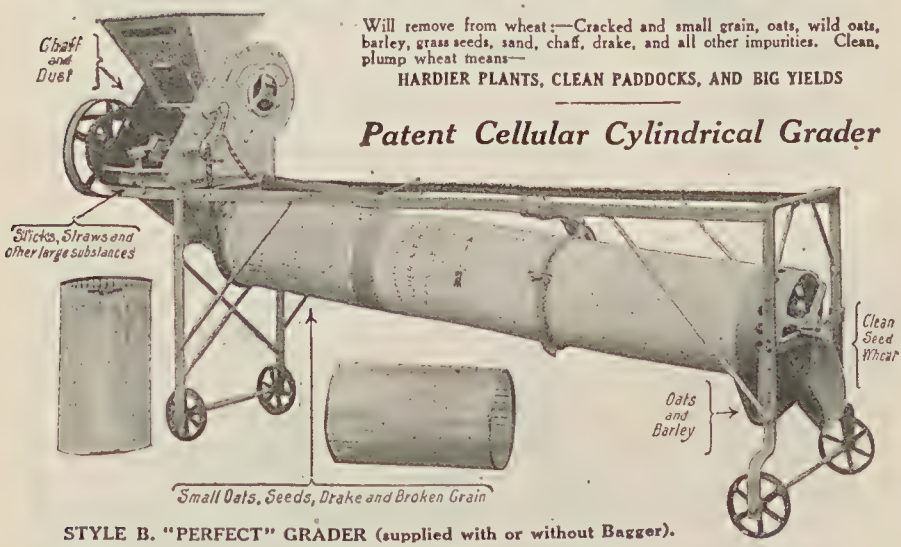
THE "PERFECT" GRADER

For Cleaning and Grading Wheat, Oats, Maize, and other Grain


Chaff and Dust
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Clean Seed Wheat
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Small Oats, Seeds, Drake and Broken Grain

Will remove from wheat:—Cracked and small grain, oats, wild oats, barley, grass seeds, sand, chaff, drake, and all other impurities. Clean, plump wheat means—

HARDIER PLANTS, CLEAN PADDOCKS, AND BIG YIELDS

Patent Cellular Cylindrical Grader

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IT STANDS UNRIVALLED

Manufactured by

SCHUMACHER MILL FURNISHING WORKS Pty. Ltd.

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Thousands of farmers now know all the comfort and economy of Electric Light and Power with—

DELCO LIGHT.

Made in 27 different styles and sizes.

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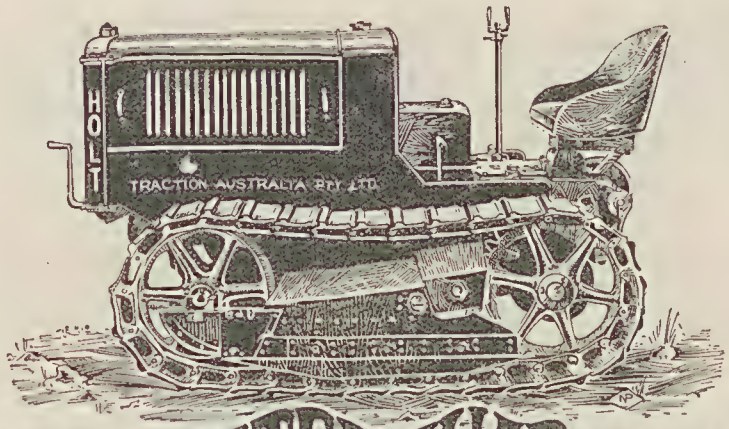
25 H.P.—3 Speed and Reverse—Electric Lights



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Model T 35 Tractor

A Tractor that weighs approximately 4,000 Pounds, that has 15 Horse Power at the drawbar, that is only 4 feet wide.—These, in brief, are the specifications of the T 35 "Caterpillar" Tractor. Big capacity for work, exceptionally low fuel and oil cost, minimum upkeep expense. That sums up its performance. Add to these the features of adaptability to an extremely wide range of work and to ALL kinds and conditions of ground and weather, ease of operation, simplicity of construction, perfect accessibility, and you have the IDEAL Tractor.

IDEAL for all classes of Farm work, such as Plowing, Seeding, Harvesting, Tank Cleaning, Sawing, Pumping, Threshing, &c.

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Department of Agriculture, Victoria.

FRIESIANS FOR SALE

(1) Bull Calf *ex* Dominion Hyacinth (374)

Dropped 29th August, 1923

Sire: **Victoria Songboy (359)** by Dominion Domino Dutch Boy (73 F.H.B.A.), *ex* Dominion Madrigal (371 F.H.B.A.).

Sire of Dam: **Oak de Kol 2nd Homestead Fobes** (imp. to N.Z. from America) (341 N.Z.F.H.B.).

Dam's Record for 273 days under Government Herd Test—
11,512 lbs. Milk, 4·08 Test, 479 lbs. Butter Fat.

For Full Lactation Period—
13,898 lbs. Milk, 4·24 Test, 589 lbs. Butter Fat.

(2) Bull Calf *ex* Victoria Oakdale Lassie (996)

Dropped 24th September, 1923

Sire: **Victoria Jo Patch (345)** by Longbeach Big Patch (515 N.Z.F.H.B.), *ex* Dominion Madrigal (371).

Sire of Dam: **Dominion Oakdale (342)** by Oak de Kol 2nd Homestead Fobes.

Vict. Oakdale Lassie is now undergoing her 1st test.

Her Dam, Dominion Proud Lassie's Record for 273 days under Government Herd Test—
11,336 lbs. Milk, 3·42 Test, 387 lbs. Butter Fat.

For Full Lactation Period—
12,216 lbs. Milk, 3·51 Test, 428 lbs. Butter Fat.

(3) Bull Calf *ex* Dominion Woodnymph (988)

Dropped November, 1923

Sire: **Victoria Jo Patch (345)** by Longbeach Big Patch (515 N.Z.F.H.B.), *ex* Dominion Madrigal (371).

Sire of Dam: **Woodcrest Jo** (imp. to N.Z. from America) (334 N.Z.F.H.B.).

Dam's Record for 273 days under Government Herd Test—
10,610 lbs. Milk, 3·17 Test, 336 lbs. Butter Fat.

For Full Lactation Period—
13,240 lbs. Milk, 3·31 Test, 439 lbs. Butter Fat.

The record of the dam—DOMINION MADRIGAL—of the sires "Victoria Songboy" and "Victoria Jo Patch" for 273 days under Government Herd Test is 11,373 lbs. Milk, 3·93 Test, 448 lbs. Butter Fat; and for Full Lactation Period 13,485 lbs. Milk, 4·17 Test, 563 lbs. Butter Fat. "DOMINION MADRIGAL" is a full sister to "DOMINION QUEEN MERCEDES," third cow of all breeds under Government Herd Test 1923, and Winner "Weekly Times" Butter Competition, Melbourne Royal Show 1923, and Champion Melbourne Royal Show 1923.

(4) Cow "VICTORIA DUTCHMAID," 4 years old, due to calve on 17th April.
Sire: Dominion Domino Dutch Boy (73). *Dam:* Dominion Milkmaid (370).

(5) Heifer "VICTORIA BELLONA," 3 years old, due to calve in May.
Sire: Dominion Domino Dutch Boy (73). *Dam:* Dominion Belle Corona (369).

(6) Heifer "VICTORIA CORIANDER" 3 years old, due to calve on 1st April.
Sire: Dominion Domino Dutch Boy (73). *Dam:* Dominion Coringa (380).

Inspection of above Bull Calves and Heifers at the State Research Farm, Werribee, is invited.

Application for Purchase to—

DR. S. S. CAMERON, Director of Agriculture, MELBOURNE

DEPARTMENT OF AGRICULTURE, VICTORIA

Red Poll Dairy Herd

The Department has now completed the orders for calves that were booked ahead of calving when the advertisement was withdrawn; consequently the booking of orders for bull calves from the forthcoming calvings has now been resumed.

BULL CALVES are sold for delivery at a month old at prices based approximately on the actual milk and butter fat record of the dam at the rate of 1s. per lb. of butter ***fat*** yielded. Thus a calf from a cow with a 400 lbs. butter fat record is sold for 20 guineas, one from a 300 lb. butter fat cow for 15 guineas, and so on. Bull Calves *ex* heifers on their first calf are sold for a set price of 10 guineas.

(For Record of Yields of dams see Red Poll Herd Book.)

The Bulls in Use include—

VICE REGAL (95 A.A.)

Sire: Nicotine (69 A.A.). Dam: Velveteen (Imp.) 22875 (2 A.A.).

VICTORIA VOLCANO (322 A.)

Sire: Nicotine (69 A.A.) by Acton Dewstone (imp.) 9524 (4 A.A.).
Dam: Tonga (253 A.) by Honingham Archbishop (imp.) 9702 (48 A.A.).
Tonga's butter fat yields for 6 successive lactation periods are as follow:—1916, 341 lbs.; 1917, 398 lbs.; 1918, 419 lbs.; 1919, 479 lbs.; 1920, 428 lbs.; 1921, 562 lbs.

BELLIGERENT (Imported) 11096 (8 A.A.)

Dam's Record (1st milking) 7144 lbs. milk.

Dam's Dam's	,,	14533 lbs. milk	...	4	years	average	12871 lbs. milk.
Sire's Dam's	,,	10370	,,	...	7	,,	,,	9354 ,,
Sire's D. Dam's	,,	9510	,,	...	12	,,	,,	8033 ,,
G. Sire's D. Dam's	,,	10215	,,	...	7	,,	,,	9386 ,,
G.G. Sire's D. Dam's	,,	12565	,,	...	10	,,	,,	8853 ,,
G.G.G. Sire's D. Dam's	,,	10088	,,	...	2	,,	,,	9754 ,,

Inspection of the Herd is Invited.

Visitors will be met at the Station on notifying the Manager, State Research Farm, Werribee.

Application for purchase to

Dr. S. S. CAMERON, DIRECTOR OF AGRICULTURE, MELBOURNE.

LUCERNE
THE KING OF FODDER · CROPS

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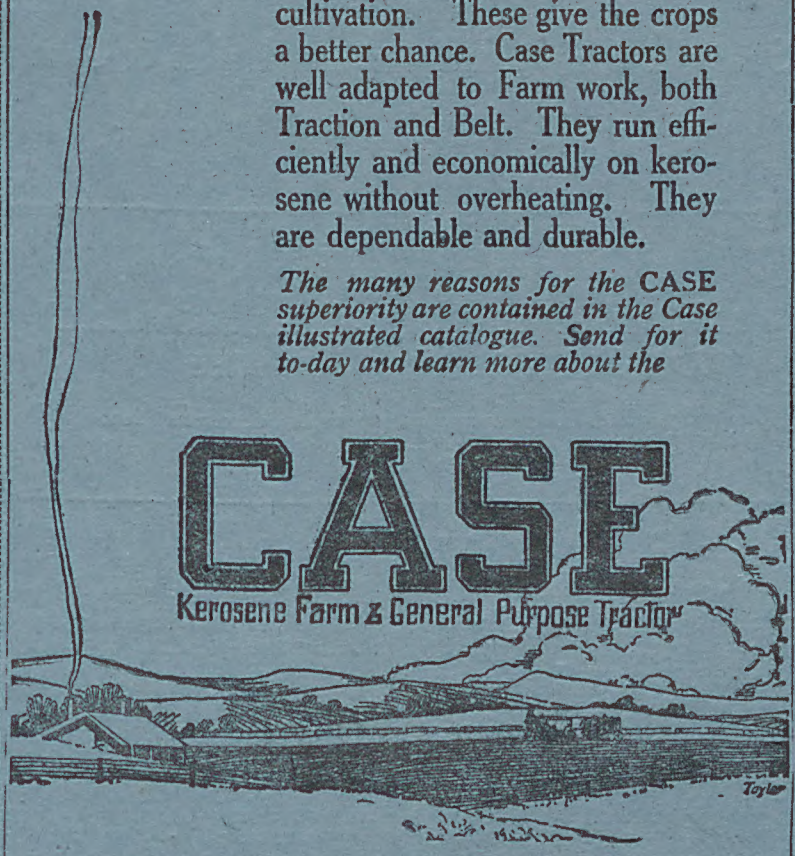

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